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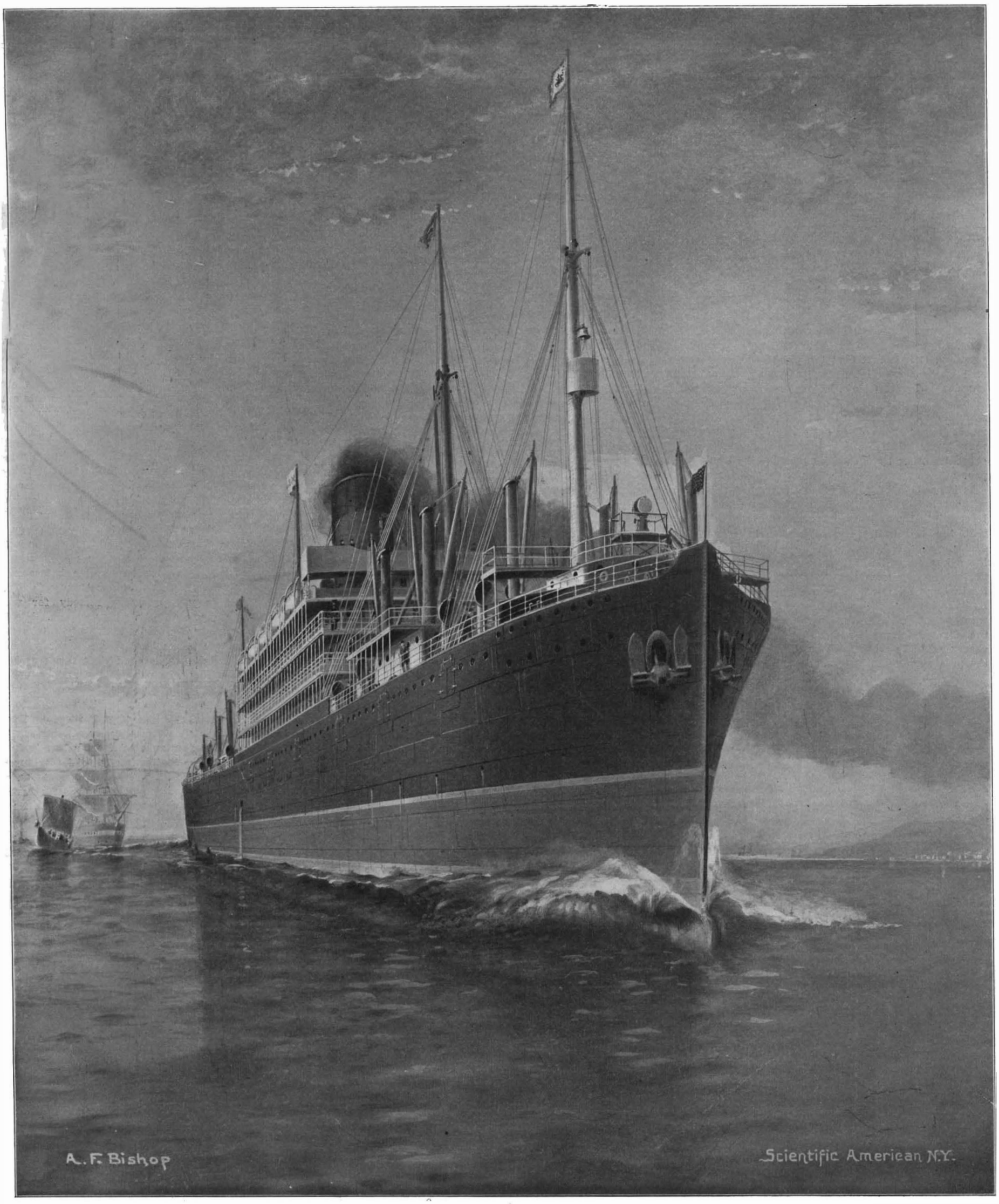

THE "MINNESOTA," JUST LAUNCHED AT NEW LONDON; LARGEST VESSEL EVER BUILT IN AMERICA.—[See page 298.]

Length, 630 feet. **Breadth,** 73 feet 6 inches. **Molded Depth,** 56 feet. **Displacement,** on 33 feet draught, 33.000 tons. **Speed,** 14 knots.

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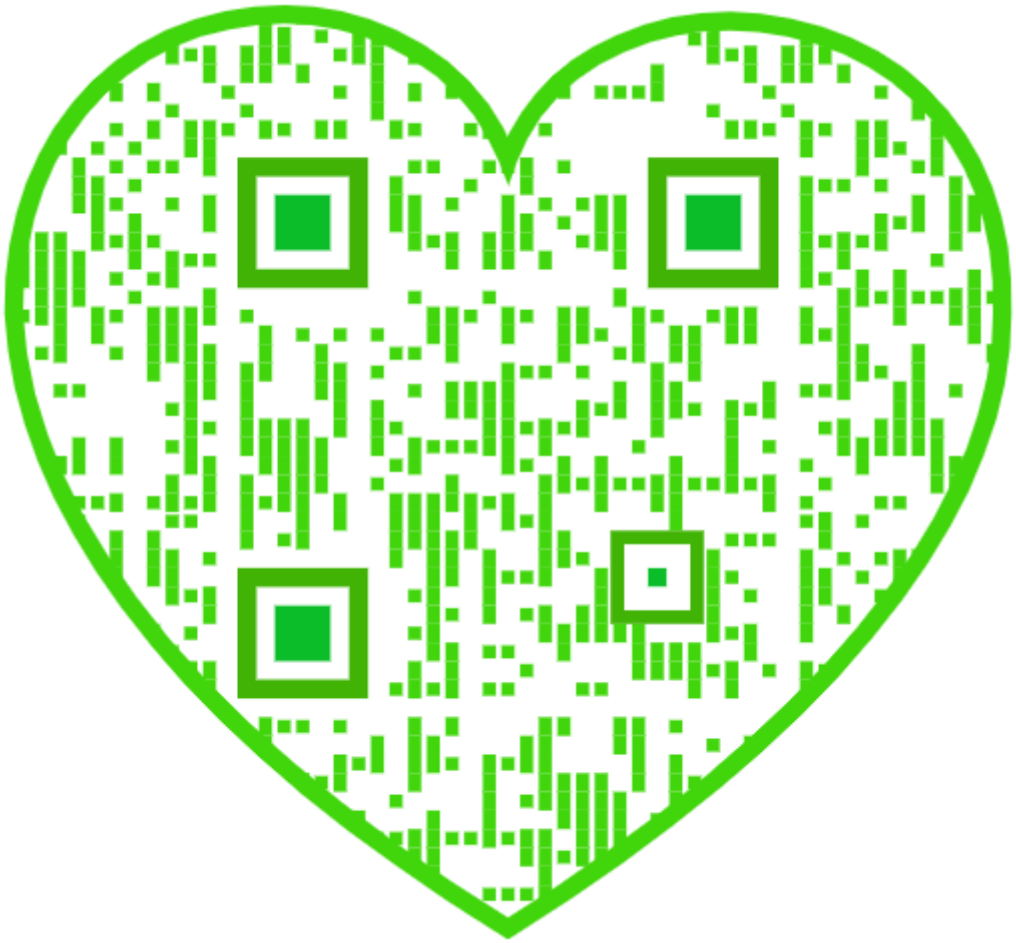

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NEW YORK, SATURDAY, APRIL 18, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

PROTECT THE THIRD RAIL.

The New York public is beginning to realize the risks of severe injury and even of death which attend the present arrangement of the third rail on the Brooklyn and New York Elevated Railways. Already there have been several accidents, some of them fatal; and although we have no doubt that in the majority of cases these accidents have been due to carelessness or disobedience of warnings and instructions, the fact remains that the third rail, as at present arranged on these railroads, is a source of very real danger. How great and far-reaching is this danger, was suggested only the other day, when a fuse blew out on one of the Ninth Avenue trains in Manhattan, and practically the whole train load of people got out and walked down the tracks to the nearest station. It may be said that they should have kept their seats; but in these days, when time is so valuable and business calls are pressing, it is a fact that the public, rather than sit still under these circumstances, will get out, take chances and walk. Now, had any of these passengers stepped on the third rail and one of the track rails simultaneously, or slipped and fallen across them, the result might have been fatal. As at present arranged, the third rail is unprotected from above, and short-circuiting by a careless person may easily happen.

Is it possible for the company to protect these rails without interfering with the operation of the trains? It certainly is; and the best proof of this is the fact that the third-rail, high-speed electric railroad recently opened between Wilkesbarre and Hazleton, Pa., has a hooded rail, which not only safeguards the public, but is free from the difficulties due to sleet and ice in the winter, which recently so greatly disorganized the elevated railroads in this city. The engineer who designed this system is the electrical expert for the elevated railways; and we have no doubt that this change could be carried out on the elevated systems if the public authoritatively demanded it.

THE LODGE-MUIRHEAD RECEIVER.

The prominence of Prof. Lodge in theoretical discussions of the Hertzian waves, lends special interest to the new Lodge-Muirhead system of wireless telegraphy, which we describe on another page. A vital part of all systems of wireless telegraphy is the coherer or its equivalent receiving device. The Lodge-Muirhead system provides a receiver which, while not differing in fundamental principles from certain previously known types of receivers, at the same time embodies a number of important features which should greatly increase its efficiency. The principle of using a thin film of oil as an insulating medium between the mercury electrode and that of the rotating disk brings to mind Branly's idea of contacts separated by a thin film of oxide. In the Lodge-Muirhead system, however, the idea of rotating one of these electrodes is a good one, for it permits better adjustment and at the same time serves to automatically re-establish the imperfect contact. The normal resistance of a coherer employing metal filings is not a reliable quantity. With the cohered particles being constantly jarred apart, the air gaps between them are liable to vary greatly in size, number, and position. Similar variations will be noted in receivers based on the principle of an insulating film, the thickness of the film at different points, though varying by an immeasurably small amount, being sufficient to appreciably affect the telephone of the relay circuit. By employing a revolving disk for one of the electrodes, a moving film of oil is carried on the disk and through the mercury. Though this film may vary in thickness to just as great an extent as between stationary electrodes, the resultant of all these variations will be an average resistance that is approximately constant. The high efficiency of the Lodge-Muirhead coherer is proved by the fact that a sufficiently powerful current may be used in the local circuit to operate a siphon recorder, thereby affording a visible record of the message.

FATAL GUN ACCIDENT IN THE NAVY.

The recent terrible gun accident on board the battleship "Iowa," in which three men were killed and several injured, is the second fatal gun disaster that has occurred in the navy within the past few months. It was only recently that there was an explosion of the charge of an 8-inch gun on the "Massachusetts," which caused the death of eight of the gun crew. In that case the charge exploded when the breech was open, and the disaster is not chargeable to any fault in the construction of the gun. In the present case it is evident that the 12-inch shell exploded just before it left the gun, and the terrific energy of the bursting of the 850-pound projectile completely smashed the chase of the gun outside the turret, driving some of the fragments down through the forecastle deck and killing and wounding the crew who were at mess on the gun deck below. So powerful was the explosion that three of the broken sections of the gun passed also through the main deck and gun deck, and only fetched up on the steel protective deck below. It is probable that the explosion was due to the fact that the fuse plug in the base of the shell, being a little too slack, allowed the flame of the explosion to pass through. This was found to be the cause of the premature explosion of shells on our battleships which took place two or three years ago. It is evident that some better method of inserting the fuse plug must be found, one that will be absolutely flame-proof when the gun is fired.

THE SO-CALLED DANGERS OF WIRELESS TELEGRAPHY.

The more or less popular mistrust and fear of wireless telegraphy is spreading, it seems, even to the technical papers. Our esteemed contemporary, the Electrical Review, recently published a sensational article on the dangers of wireless telegraphy, and further indorsed this article by favorable editorial comment. The absurdity of the whole matter is apparent when one stops to consider that the electric surgings set up in the receiving antenna by the Hertzian waves, though of very high voltage, are, on the other hand, of such an infinitesimal quantity that the most delicate of instruments is required to detect them. The writer of the article referred to, argues that "a great disturbance must be made at the center of an imaginary sphere in space, in order that even the small electromotive forces necessary for signaling may be developed in an electrically-tuned conductor, forming a tangent to the sphere, of infinitesimal length compared to the sphere's radius;" and that this disturbance must be so great that "the electric radiation of power to work a coherer across the 3,000 miles of the Atlantic would be sufficient to develop visible sparks across an air gap in a receiving system located within three miles, or one one-thousandth of the distance, even though they be not in tune with each other. Then he goes on to say that a telegraph or telephone circuit within this three-mile radius, particularly if the wires were run vertically to the top of a modern skyscraper, would similarly respond to these oscillations; and if the circuit contained a spark gap, such as that of an open-spaced lightning arrester, "a narrow break in some open translating device, or a loose joint in the wiring," we would have "an opportunity for a fire whose origin would certainly be of the mysterious class whose cause it is the fashion to assign to defective electric wires. At any rate, there would be a possibility of grounding the circuit and rendering it inoperative."

The whole discussion illustrates the recklessness with which some writers launch forth on an elaborate argument not based on facts or figures. The writer in question evidently overlooked the quantity of current set up at a transatlantic or even a local receiving station, overlooked the power generated at a Marconi receiving station, and above all overlooked the laws governing the radiation of Hertzian waves. According to his argument, Hertzian waves radiate in all directions, filling an imaginary sphere. Their energy would, therefore, vary inversely as the square of the distance, or, in other words, the energy at a distance of three miles would be one million times that at a distance of three thousand miles. As a matter of fact, Hertzian waves as set up by an oscillator travel out in a plane at right angles to the antenna, so that, roughly, their intensity is inversely proportional to the actual distance, and the efficiency at the three-mile station would be only one thousand times greater than that at the three-thousand-mile station. His deductions lead to the supposition that Mr. Marconi's "powerful thunder stations," as he calls them, must generate a quantity of electricity equivalent to that of lightning in order to cause visible sparking at a distance of three miles. Now, as a matter of fact, only 7 kilowatts were used in transmitting President Roosevelt's message to King Edward across the Atlantic. Furthermore, we are informed that Mr. Marconi's experiments are constantly leading toward a reduction rather than an increase of power. The writer of the article certainly overestimates the quantity of current generated in the receiving antenna, for, even within the three-mile limit, the quantity is immeasurably small. Even at the sending station the current must be reduced to an infinitely small fraction of an ampere in order to obtain the best results. In fact, we have held a piece of paper in a spark which was capable of affecting a coherer 50 miles distant. The paper was punctured, but not ignited, because, though the heat was very intense, the quantity generated in the spark was very small. What dangers of fire could ever arise from such cold sparks as these, to say nothing of the minute sparks set up in surrounding air gaps, which represent so small a fraction of the energy in the transmitting spark? As for the dangers of grounding a circuit by means of open-space lightning arresters, we can safely say that no spark of sufficient length to accomplish such a result can be generated within a short distance of the most powerful transmitter in use, even with the circuits perfectly in tune with the sending antenna.

WASTE OF CITY WATER SUPPLY.

The Commissioner of the Department of Water Supply, Gas, and Electricity, has given out some figures of the results obtained in his investigation of the question of the waste of water in this city. By dividing the city into districts, and by means of meters, supplemented by investigation, it has been possible to determine the amount of water served to each district daily, and also to determine what use is made of it. One method of calculating the waste is to examine the flow of water in the sewers during the early morning, when the consumption is lowest. A number of men are then sent through the buildings in the particular district under consideration, to measur the amount of water that is running to waste from leaky faucets, and similar fixtures. These measurements however, do not include water that is running to waste from overflowing tanks, nor does it take account of waste that occurs when the water is allowed to run on cold nights to prevent freezing; nor does it include underground leaks and leaks in the mains. As a result of this investigation, the conclusion is reached from the work already accomplished that 32,000,000 gallons, to 12 per cent of the Croton water, is running to waste every day from leaky fixtures, this percentage representing merely the waste in buildings from defective plumbing, which is a constant waste, and continues steadily throughout the dry weather, when the supply is scanty. It is estimated that this amount of water, if it were metered, would bring to the city $1,500,000 a year, and evidently it would be well worth while to recover the value of this water for its own sake, to say nothing of its value considered as forming a part of an already inadequate supply for the city, and the possibility that unless the source of supply be multiplied, we may have to face a water famine before many years have gone by. Commissioner Monroe is of the opinion that the most effective remedy for water waste is the extension of the meter system. His bill before the Legislature provides that all buildings shall be metered where steam is used for power purposes, and also all buildings that are over five stories in height. As the city will pay for the meters, the installation will not be hard upon the consumers, while the expense to the city will be light compared to the saving due to the prevention of water waste. Everyone who has the interests of the city at heart, and is disposed to look at this subeject from a broad-minded standpoint, will agree that it is of vital importance to the city of New York that water waste should be prevented, and everything possible done, whether by metering or some other method, to conserve its already inadequate supply.

ANNUAL REPORT OF THE UNITED STATES STEEL TRUST.

What is probably the most complete and circumstantial report ever issued by any great American corporation is the annual report of the United States Steel Trust, which has just been made public. The magnitude of the operations of this concern is shown by the following figures, which are taken from the report. The value of the properties owned and operated by the several companies that make up the trust is $1,325,000,000. Other assets, among which are included cash to the extent of $50,000,000, bring up the total assets to the sum of $1,547,000,000. It may be mentioned that the single item of $50,000,000 cash is equal to the amount voted by Congress at the outbreak of the Spanish war. The liabilities consist of $508,000,000 of common, and $510,000,000 of preferred capital stock. To this is to be added $361,000,000 of bonded and debenture debt, $50,000,000 of current liabilities, $25,000,000 sinking and reserve funds, and $78,000,000 undivided surplus of the United States Steel Corporation and subsidiary companies, which, with other items, brings up the total liabilities to $1,547,000,000.

The volume of business done by all the companies during the year, including sales between the companies and the gross receipts of transportation and miscellaneous properties, reached the total sum of $561,000,-

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000. The manufacturing and operating expenses amounted to $411,000,000, leaving a balance of $149,000,000. Other expenses, interest charges, etc., brought the net earnings for the year to $133,000,000.

During the past year this corporation mined 16,000,000 tons of ore and 709,000 tons of coal, besides manufacturing 9,522,000 tons of coke. The iron produced by the blast furnaces aggregated 7,976,000 tons. The production of Bessemer ingots was 6,759,000 tons, and of open hearth ingots 2,985,000 tons. Under the head of rolled and other finished products for sale, we find that the corporation turned out 1,921,000 tons of steel rails, 1,255,000 tons of merchant steel, shapes, etc., and 1,123,000 tons of wire and products of wire. Other manufactures, such as blooms, plates, tubes, sheets etc., brought up the total output of finished products to 8,197,000 tons for the year. The present activity of the corporation is shown by the fact that the unfilled orders on the books at the close of 1902 amounted to 5,347,000 tons of manufactured products.

The average number of employes of the corporation during the entire year was 168,127, to whom the aggregate amount paid during the year in wages was $120,528,343. Of this total number of employes, 125,326 are employed in the various manufacturing properties. Finally, it is of interest to know that the total number of stockholders in the year 1902 was 58,629, which does not include the subscribers for preferred stock, nor 27,379 employes who availed themselves of an offer made them during last December.

THE ACCESSION OF GERMANY TO THE INTERNATIONAL CONVENTION.

The German Ambassador at Bern has notified the Swiss Federal Council that the German Empire will join the International Convention for the Protection of Industrial Property of March 20, 1883, as modified by the Act of the Conference at Brussels of December 14, 1900. The accession of the German Empire to the International Convention is to take effect on May 1, 1903.

The citizens of the United States and of the other signatories to the International Convention will therefore shortly be able to take advantage in Germany of the provisions of the treaty, the most important of which is that section which enables an inventor to file his German patent application during the year following the filing of his patent application in the United States, and to secure the United States date of filing as his date of priority in Germany, irrespective of the issue of the United States patent. As under the present law it is necessary to file a German patent application before the invention is disclosed in public print in any country, the amended provisions of the patent law will be availed of by many United States inventors, who, under the old practice, were debarred from protecting their inventions in Germany, because of the publication of their inventions, either on the issue of the United States patent or in connection with the introduction of the inventions.

THE REINTERMENT OF JAMES SMITHSON IN AMERICA.

Not so long ago the Italian government decided to remove all the bodies in the little cemetery of Genoa. That decision would not, in itself, very greatly affect the United States, were it not for the fact that in the cemetery in question the remains of James Smithson were interred in 1829. When the Smithsonian Institution was notified of the contemplated abolition of the cemetery, its Board of Regents decided to have the body removed to another cemetery in Genoa. Dr. Alexander Graham Bell asked the board to reconsider its action, and announced that he was ready to defray the expense of bringing the remains to this country. The proposition was favorably received.

It would be most fitting that the body of Smithson should find a last resting place in the country which he so greatly benefited. Foreigner though he was, Smithson gave his entire fortune of over $500,000 "to the United States of America, to found at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men." The gift is all the more remarkable, coming, as it did, from a man who had never seen this country and who was utterly unknown to us. It is pleasing to note that the faith which he had in the young republic has been justified in the benefits which the Institution that bears his name has conferred upon Americans. Perhaps more than any other public institution of the country, the Smithsonian Institution has stimulated scientific research among Americans.

A REGULAR TRANSATLANTIC MARCONI SERVICE.

At the time of his last visit to New York, Marconi informed a representative of the SCIENTIFIC AMERICAN that in the course of a few months a regular transatlantic wireless telegraphic service would be established. The promise then made has now been fulfilled. In its issue of March 30, the London Times headed its foreign news with two New York dispatches of about two hundred words each, which were received "by Marconigraph." A leader in the Times states that the message marked the establishment for the first time of the regular transmission of news by the Marconi system on a contract basis. After pointing out that messages can be sent from the United States to England at a cost but little in excess of the cable rate from England to France, the Times comments upon the slowness of Englishmen to appreciate at its true worth the meaning of Marconi's work. It says:

"They may rely upon it that considerable interests are going to be seriously affected by the new developments, and they would do well to cultivate whatever scientific and economic imagination they may possess.

"In the same way those who are responsible for national interests ought to very carefully watch and anticipate the bearing upon various strategical problems of the agency that more than ever before annihilates space and time."

The Times, it is said, will have for the present a monopoly of this system of carrying news, as the number of words that can be sent is rather limited.

NEW AMERICAN AUTOMOBILE SPEED RECORDS.

That the Ormond-Daytona beach is an ideal racing course, as one would expect from a glance at the illustrations of it in our recent Automobile and Yachting number, was proved by the breaking of several American speed records in the trials held there the last of March. A new kilometer record of 32 4-5 seconds was made by Winton in his "Bullet" racer. This was 2 seconds better than the time made by Fred Walsh on Fournier's Mors racer at the Staten Island speed trials last May. Winton also came within 2-5 of a second of equaling Fournier's mile on the Coney Island boulevard, by making this distance in 52 1-5 seconds. This is the fastest mile ever run by an American machine driven by an American. The present world's record figures for the mile and kilometer are 46 and 28 seconds respectively. Mr. Winton also reduced his 10-mile track record of 10 minutes, 50 seconds to 10:26 1-5. This included making a turn at the end of the 5-mile stretch. According to the stop watch of the gentleman who rode with him, Winton made the first 5 miles in 4:46 1-5.

The former American mile and kilometer records for cars under 1,000 pounds, made by L. C. Thompson on a Renault machine, were badly beaten by H. T. Thomas on a special 825-pound Oldsmobile racer. These records of 1:35¾ and 59 seconds were reduced to 1:06 1-5 and 42 seconds respectively. The motor bicycle records of C. H. Metz on an Orient of 1:10 2-5 and 43 3-5 seconds for the mile and kilometer were beaten by Oscar Hedstrom on an Indian motor bicycle, the new times being 1:03 1-5 and 39 seconds.

RUBBER VINE IN HONDURAS.

Recently Señor Don Floriano Davadi, governor of the Department of Conyagua, Honduras, informed the American consul at Tegucigalpa that some time previous he discovered in the Pijo Mountains a vine growing in an uncultivated state, varying in diameter from 4 inches to 2 feet, which on cutting produces a sap the nature of which is rubber. These vines grow to 100 feet in length, and they are said to belong to the African family of rubber vines. In Honduras, no one seems to know the name of the vine or the botanical family to which it belongs. The discoverer regards it as superior in quality to the Para rubber of commerce, and asserts that his convictions are borne out by the analyses made by American and European chemists.

The vine thrives at great altitudes as well as in the lower valley levels. Such luxuriance of growth has this plant attained that it is quite capable of being cut in commercial quantities. It may be quickly propagated in the rich soil of the Department by means of seedlings, and the growth being so much faster than that of rubber trees, Señor Davadi thinks the quantity of gum obtained would be large. The trees require six years' attention before sapping can begin.

It has been proposed to form a company for the exploitation of rubber in the Yoro district, but though the names of several prominent men have been connected with the enterprise, nothing has, as yet, been done to begin operations.

REPORT OF THE BERLIN-ZOSSEN TRIALS.

Chief Engineer Reichel has at last published his report giving the results of experiments made with high-speed electrical trains on the military road between Berlin and Zossen. At a speed of 100 miles an hour the electromotive force was 15,000 volts. Mechanical power equal to 2,500 horse power was used in starting the trains, which, when at full speed, required only 700 horse power. Mr. Reichel, in his report, gives it as his opinion that a speed of 125 miles can be attained, provided the required amount of electric energy can be supplied, as when at full speed from 1,400 to 1,500 horse power is required. For freight transportation also, electric power gave good results. A train of 200 tons gross weight was easily moved, even over grades of 1.2 per cent, at a speed of 32½ miles an hour. Through the possibility of supplying the motor car directly with a current of 10,000 and more volts, the weight of the motor cars and that of the transformers could be reduced from 92 to 78 tons.

SCIENCE NOTES.

Prof. Spring (Chem. Zeit.) has examined the commonly accepted theory advanced by Hagenbach, that the blue color of the sky is due to the refraction of light caused by solid or liquid particles floating in the air. In laboratory experiments the author never succeeded in obtaining the blue color, the reflected rays of light always showing either red, yellow or violet. Purification in no case removed the blue tint from the air. After exhausting all physical means in an attempt to reproduce the blue color, the author concluded that the blue of the sky depends upon chemical conditions. The color deepens instead of fades as the observer rises above the earth. These conclusions are supported by the fact that liquid air is also blue.

M. J. Thoulet has investigated the constitution of the ocean bed, and finds that the more deeply it is penetrated, the less the proportion of slime and the less calcareous matter. On the other hand, the proportion of sand grains and pure clays increases with the depth. No regularity obtains in the distribution of the non-calcareous mineral grains. This normal distribution appears to be more pronounced the deeper the ocean bed itself lies below the water surface, but, in any case, the variations due to ocean depth are small. Even in the deepest water the constitution of the bed shows traces of the conditions prevailing near the surface of the ocean above the bed. The latter remark is of importance, as the author points out, when we consider that a complete analysis—chemical, mechanical, and mineralogical—applied to ancient geological strata is competent to shed a flood of light upon the ancient conditions that prevailed at the surfaces of oceans that have long since disappeared, leaving no trace other than their effect on the ancient ocean beds.

C. Delezenne finds that the venom, both fresh and dried, of the cobra, the adder, and the puff adder, all contain a peculiar ferment, a kinase, which, although itself without proteolytical action on albumin, is able to impart to pancreatic juice a very powerful digestive action on that substance. This ferment is entirely destroyed by heating the venom to 100 deg. C. for fifteen minutes. The poison of the puff adder is the most active in this respect, 0.5 to 1 mgm. of the venom being sufficient to enable 1 c.c. of pancreatic juice to digest 50 cgm. of albumin in ten or twelve hours. Cobra poison was found to be slightly less active in this respect, while that of the viper had a marked lower proteolytic action, five or ten times more being requisite to produce the same effect. The kinase appears to resemble in its properties the ferments secreted by certain micro-organisms, and to possess the same action as the enterokinase of the intestinal juice. The part played by this substance in serpent venom is being investigated.

Metallic construction appears to have had a very low power of resistance during the volcanic eruption at St. Pierre. Not only was it incapable of withstanding the weight of the burning matter, says the American Architect, but some chemical action is likely to have taken place which transformed the particles. M. Amedée Knight, a senator of Martinique, was on the island at the time of the disaster, and he has been able to furnish details about the destruction which were not observed by others. He describes the effects shortly as corresponding with those which might be expected if some colossal Nasmyth's hammer had been employed in operation on the town. Most things have been reduced to a fine powder. One of the cases mentioned is the market of St. Pierre. After the cyclone of 1891 the authorities decided to reconstruct it in the most solid manner. Cast-iron was adopted. It is now impossible to find the slightest trace of a construction which had an area of 2,000 meters square.

A new and interesting departure in the shape of ships' hulls has been designed by Constructor Kretschmer, of the German Naval Department. He has been led to make this innovation in the desire to increase the efficiency of a vessel, without at the same time an abnormal augmentation of the coal consumption. Prof. Kretschmer, instead of designing the hull somewhat after the form of a fish, has taken as his model an aquatic bird, which, like the ship, makes its way along the surface of the water. In his design the ship's hull has the shape of a tetrahedron or double wedge. By this means it is anticipated that the efficiency of vessels will be increased by fifty per cent. Another great advantage is that such vessels will have no wash.

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THE PEDRAIL--A NEW TYPE OF ROAD LOCOMOTIVE.

BY HERBERT C. FYFE, LONDON.

The ideal conditions for a rolling wheel are a hard, smooth wheel rolling on a hard, smooth track, and inventors have employed their ingenuity in devising vehicles which would lay down rails as they went along, thus providing a movable track. No system of putting down temporary rails by the machine itself and picking them up again has ever been a practical success; but quite recently there has been invented a machine which does the reverse of this. In the "Pedrail" system—the invention of Mr. Bramah Joseph Diplock—wheels are placed upon the ground and fixed rails, attached to the carriage, glide over them.

This new type of wheel has been applied to a traction engine with excellent results.

The accompanying diagram reveals the principle of the "pedrail." A disk is keyed to the driving axle, on which disk sixteen sliding spokes are mounted. The extremity of each spoke carries a foot pivoted by a ball-and-socket joint in order that it may have a limited free movement to suit the surface of the road. On one side of each spoke, and projecting beyond the disk, is a small wheel or roller. Each spoke is provided with a spring on the other side of the disk, by which spring the spoke can be drawn inward. The springs radiate from the center and are not shown in the diagram. On the axle box a rail is mounted, which is pivoted to a flat plate or guide, forming part of the axle box. The pivot of the rail has free vertical movement in a slot formed in the plate. The engine is supported by the rail through the medium of two springs abutting against the top lever pivoted to the top of the axle box. Two inner guides are provided to lead the wheel or roller under the rail. All the levers and springs on the axle box lie flat against the disk, from which it follows that the rollers projecting from the disk are arranged around the guide and the rail. The disk and the pieces attached to it (spokes, rollers, and plate) revolve. The axle box with its attached parts (dependent lever, guides, rail, and springs) does not revolve. Hence a roller, starting from the top of the disk, strikes the guide and gradually forces the sliding spoke outward, thereby enabling the foot to turn on its ankle joint by its own weight as it comes down and to drop with its full surface on the road. The roller then passes under the rail in the manner illustrated.

In an ordinary railway a rail is laid down, and wheels are run over it. In the Pedrail, wheels or rollers (mounted on feet shod with rubber) are laid down, and the rail is run over them. The principle is the same, only the railway is inverted. It is, in brief, a combination of an *inverted* endless railway with a walking or trotting machine.

After witnessing trials of the Pedrail, Prof. Hele-Shaw said that Mr. Diplock had secured a means which makes it possible to draw a load not merely over roads, but over agricultural land, fields, and plains, and even to climb mountains; "in a word, not only has he, in my belief, a tractive agency which makes his vehicle able to traverse the worst possible roads without the slightest difficulty, or to pass over ordinary roads in any weather without doing the slightest injury to them, but he has solved the problem of a self-propelled vehicle and traction engine which is absolutely independent of roads at all."

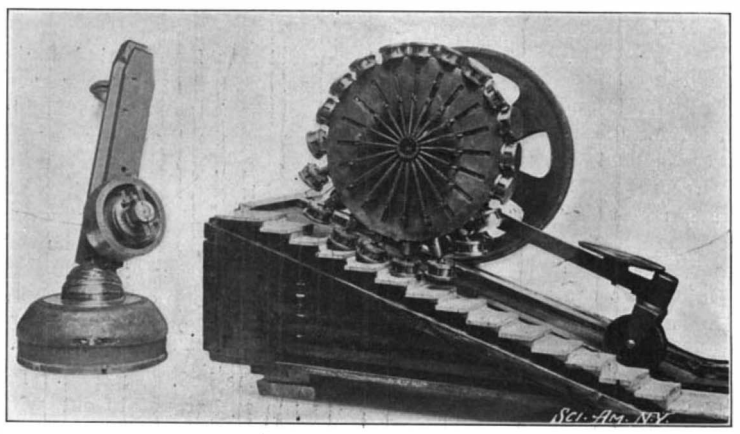
Chief among the merits of the Pedrail is the reduction of the wear and tear of the road surface. Heavy vehicles with ordinary wheels do endless damage to the highway, but the Pedrail, in that it tends to beat down the projections without increasing the depressions in the road surface, actually tends to improve the road. The fitting of rubber tires on heavy vehicles is a costly process. The rubber soles for the Pedrail are not made of pure rubber, the buffer action necessitating an admixture of other material to harden it. The cost of soling an entire Pedrail would not exceed $25.

Furthermore, the Pedrail gives the maximum of road adhesion and the minimum of road resistance.

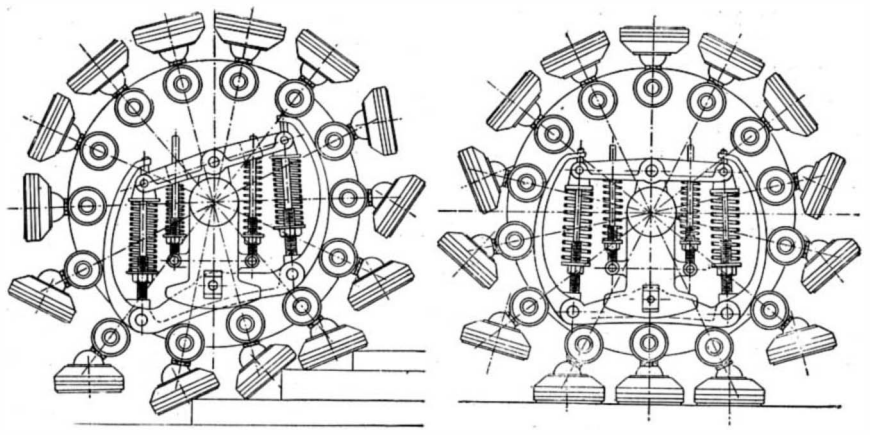
A vehicle fitted with pedrails can travel over the worst roads, can be used where no roads exist, can climb stiff viaducts, and can surmount with ease obstacles in its path. In trials the Pedrail walked over 9-inch planks, and passed over large stones without crushing them and thus distorting the road surface.

The life of an ordinary traction engine is commercially about four or five years, whereas some English railway locomotives have been in use for thirty or forty years. Mr. Diplock believes that with such an arrangement of springs as he has devised, the life of a road engine would assimilate itself more nearly to that of the railway locomotive. This, of course, would be a very important gain as regards working expenses.

The whole of the working parts of the Pedrail, with the exception of the projecting square steel spokes and the rollers, are dust and dirt proof, and are lubricated automatically from one central supply chamber, which holds a surplus supply of oil. The square spokes work in and out upon reciprocating ball bearings, and have a special provision in renewable dust-proof plates round them.

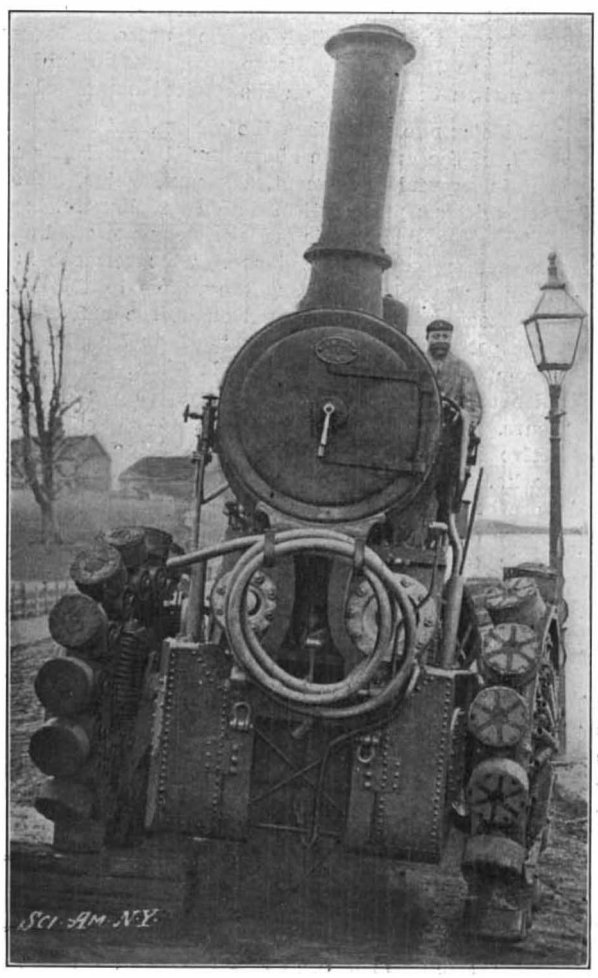


MODEL SHOWING THE PEDRAIL ASCENDING A STAIRWAY.

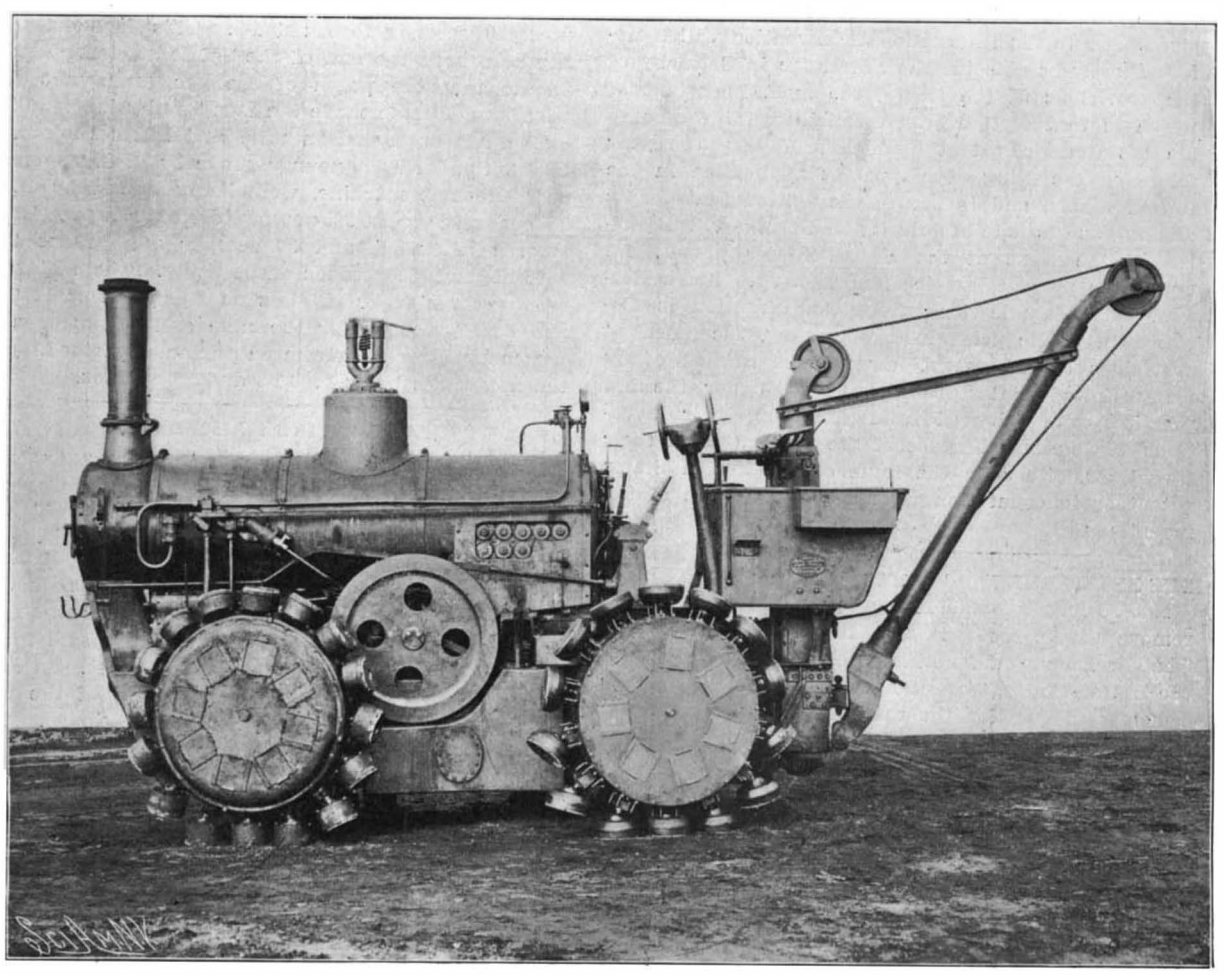


Position of the parts in overcoming obstacles. Position of the parts on a level road.

THE PRINCIPLE OF THE PEDRAIL'S OPERATION.



A PEDRAIL TRACTION ENGINE SURMOUNTING AN OBSTACLE.



DIPLOCK TRACTION ENGINE FITTED WITH PEDRAILS. ALL FOUR WHEELS ARE DRIVERS.

A Marconi Plant for International Use.

A Marconi station is to be located at the pier of the American Line at the foot of Fulton Street, North River, New York city, so that vessels held outside of the harbor during fog may communicate with the city at once. The use of the new station will not be restricted to the vessels of the International Marine Company. Any steamer equipped with the Marconi apparatus will have equal privileges. The station will be for the use of the general public.

The mammoth Brady union stockyard at Atlanta, Ga., which is said to be as large as anything of its kind in the country and the only one in the South, has just been finished at a cost of $500,000. It covers thirty acres and has accommodations for five thousand head of cattle and two hundred men. The auction mart is said to be the largest in the world, being 60 by 400 feet. A pretentious hotel has been erected on the grounds, which is encircled by a half mile track. It is hence possible for prospective buyers to South the porch and watch the movements of animals in which they may be interested.

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THE LODGE-MUIRHEAD SYSTEM OF WIRELESS TELEGRAPHY.

BY H. C. FYFE, LONDON.

Through the courtesy of Sir Oliver Lodge and Dr. Alexander Muirhead I was enabled the other day to inspect the working of the Elmer's End to Downe wireless telegraph installation in Kent. For some years past experiments have been carried out quietly in a shed at Elmer's End, adjoining the works of Messrs. Muirhead & Co., and also in another shed situated at Downe, some eight miles away.

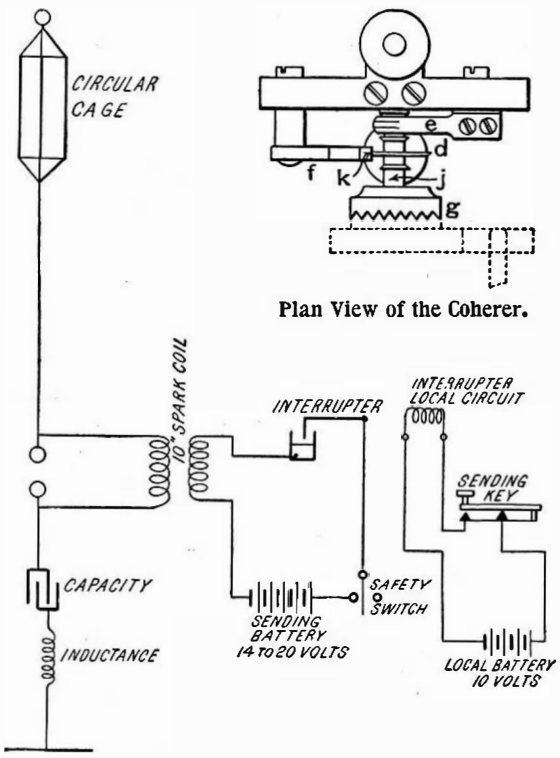


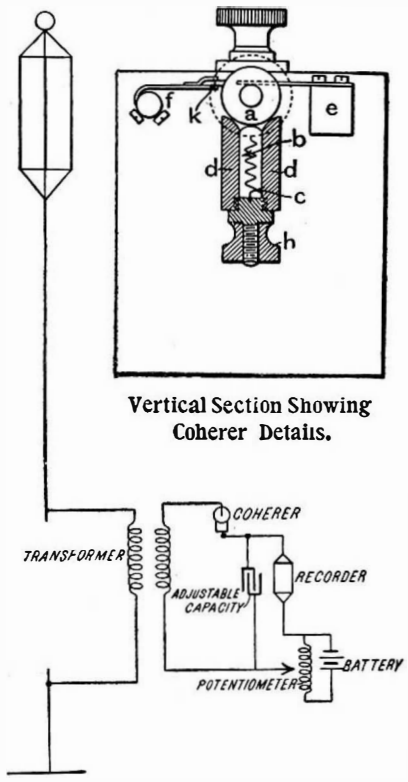
Diagram of the Receiving Station.

Plan View of the Coherer.

Between these two stations signals have been exchanged for a considerable period, but it was only quite recently that the inventors were sufficiently satisfied with their system to bring it before the notice of the cable companies. After a searching series of trials, the experts of the Eastern Extension Australasia and China Telegraph Company reported favorably on the new method, and as a result Lodge-Muirhead wireless telegraph installations have been sent out on the two new cable ships "Restorer" and "Patrol," belonging to the above-mentioned company, which have recently been dispatched to lay the new cable ordered by the Dutch government for use between Balikpapae, in Borneo, and Metado in the Celebes.

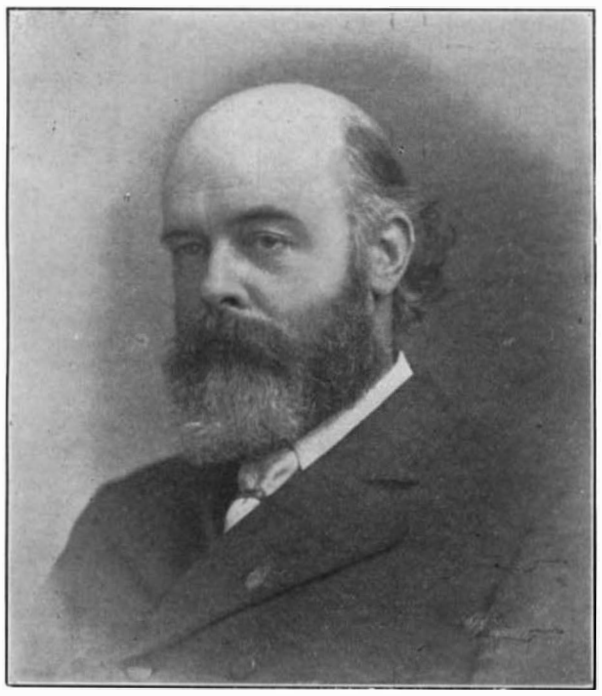
This, it may be noted, is the first commercial application of the new system which we propose now to describe.

The Lodge-Muirhead receiver consists of a small fine-edged steel disk which is kept rotating by clockwork on a globule of mercury, from which it is separated by a thin film of oil. The construction of the receiver may be better understood by reference to the detail views, in which the disk is designated by the letter *a*. The mercury, *b*, is contained in a cup, *d*. Electrical connection is made therewith through binding screw, *h*, and the platinum wire, *c*. A copper brush which bears on the shaft, *j*, communicates current to the disk, *a*. A small cushion of felt, *k*, held in a spring support, *f*, serves to keep the edge of the disk clean. The disk is coupled to a clock mechanism by the ebonite clutch, *g*. The film of oil which covers the mercury acts as an insulator and prevents the passing of the current in the local circuit. The ef-

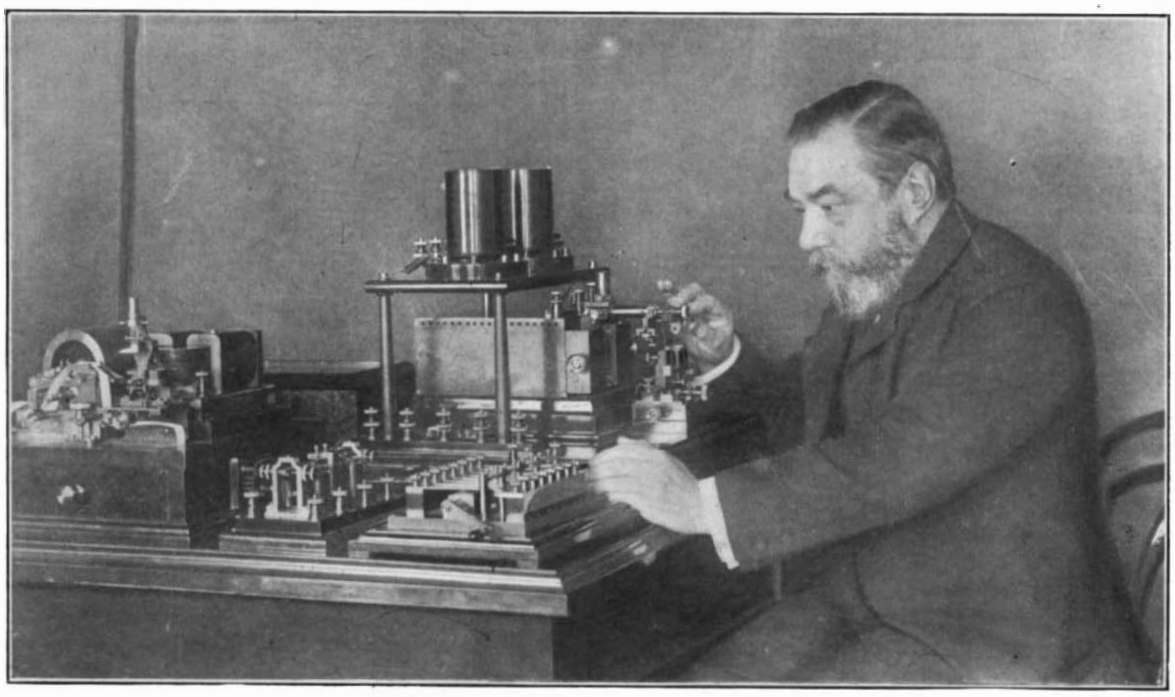


Vertical Section Showing Coherer Details.

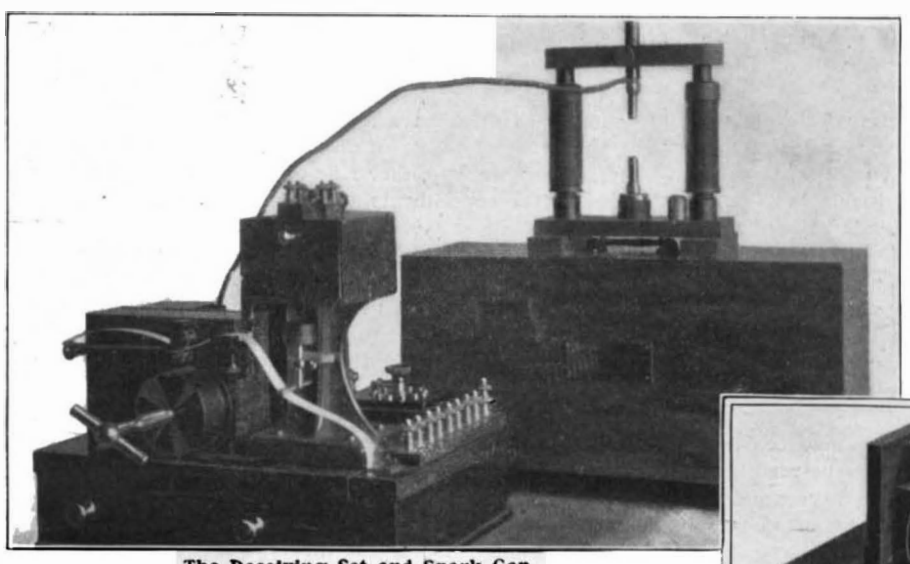
Diagram of the Sending Station.



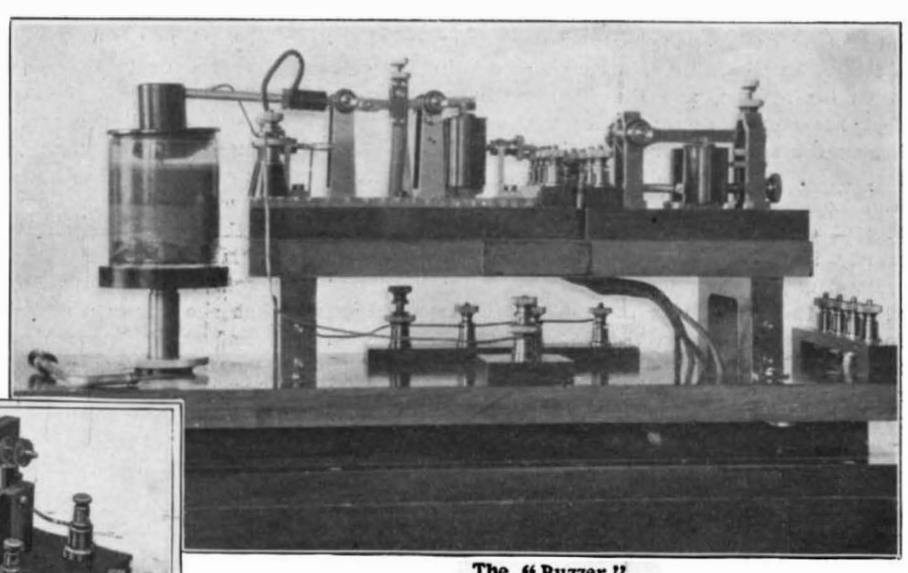
Sir Oliver Lodge.



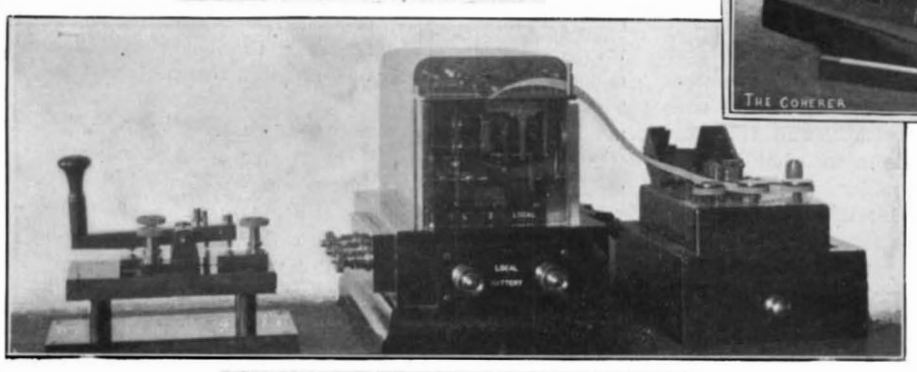
Dr. Muirhead Adjusting the Delicate Coherer.



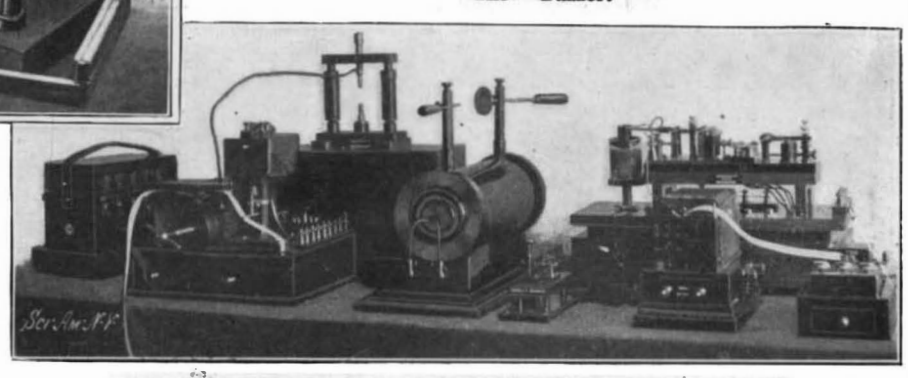
The Receiving Set and Spark Gap.



The "Buzzer."



The Automatic Transmitter with Perforator.



Complete Station, Comprising Transmitting and Receiving Sets.

THE LODGE-MUIRHEAD SYSTEM OF WIRELESS TELEGRAPHY.

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fect of the oscillations sent out from the transmitting station is to break down the film of oil which covers the mercury and to establish contact between the disk and the mercury, thus completing the circuit of the receiving instrument. No tapper is required, as the coherer automatically decoheres, and no relay is needed, as the current is quite strong enough to work the Muirhead siphon recorder; the clockwork draws the slip on which the signals are pivoted, as well as driving the disk.

The plan of the receiving station can be seen in one of our diagrams. The vertical wire used at the Elmer's End station is 80 feet high, and on it is hung a light wire cage or capacity; an increase in the size of the capacity is necessary when larger distances require to be bridged for wireless communication. The cage is made up of four copper wires strung on to wooden loops with a copper ball above. One end of the wire is led through a capacity and inductance, and is connected up to the shed itself instead of being earthed. The other is led through the secondary coil of the transformer to the coherer.

The current passing through the coherer is led through an adjustable capacity to the Muirhead siphon recorder. The remaining apparatus at the receiving station comprises a local battery, and a potentiometer to regulate the potential of the coherer. The employment of a transformer in the receiving circuit was one of Sir Oliver Lodge's earliest improvements and one which is made use of by Marconi in all his long distance work.

The apparatus employed in the transmitting set consists of a local battery of 10 volts, a sending key and an interrupter for the local circuit. The sending battery may have a voltage of from 14 to 20. A novel feature is the use of a "buzzer," viz., a couple of telegraphic sounders acting reciprocally, which operate a mercury make and break for the 10-inch spark coil. To one of the sounders is attached an aluminium needle dipping into the mercury. This forms a uniform and easily adjustable interrupter for the induction coil, allows the operator to have perfect control of the sparking frequency, and also does away with the possibility of his receiving shocks, which are liable to occur when the primary of the induction coil is directly broken by the key. After passing through the coil the current is led to two small brass rods between the ends of which sparking takes place.

Sir Oliver Lodge, F. R. S., the principal of Birmingham University, has been experimenting with Hertzian waves for a great many years past. On February 24, 1899, he delivered a lecture on coherers at the Royal Institution. A coherer was defined as an instrument which responds to electric waves somewhat in the same manner as a microphone responds to sound waves. Many different forms of coherer were shown, but no mention was made of the steel disk rotating on mercury, as this had not been discovered at the time. On June 1, 1894, Dr. Lodge delivered a lecture at the Royal Institution on "The Work of Hertz," and showed for the first time in England that electric Hertzian waves could be detected by means of suitable receivers through walls and closed doors, when set up by a transmitting or exciting apparatus some hundreds of yards away. In 1897 Mr. Marconi arrived in England with his system, and though Sir Oliver Lodge has kept his results secret until now, he has been working on the subject ever since his lecture in 1894. His first trials were over distances of 40 yards, and now the Lodge-Muirhead system has been operated perfectly at distances of 60 miles. The system was temporarily installed between Holyhead, in the Isle of Anglesea, and Howth, in Ireland.

"God save the King" was the message that passed hundreds of times between the transmitting and receiving stations.

It may be noted that the Cunard liners using the Marconi apparatus often intercepted the signals. The inventors are now working on the question of tuning or syntonization, and they have succeeded in tuning the oscillations passing between two stations so that only the properly tuned receiver shall respond to its own special transmitter.

They are of opinion that their devices, which I am not at present at liberty to make public, will neutralize the interference from any station not less than 10 miles distant, and will also prevent their signals from being read by any other station the same distance away.

The 8-mile Elmer's End to Downe circuit is a very difficult one, owing to the intervening hills, and it would correspond to a sea circuit of quite 60 miles.

During a voyage of the Liverpool steamship "Vedamore" across the Atlantic, signals were exchanged between the ships and the shore over considerable distances, and the system was also tried with success between Washington and Baltimore, a distance of 45 miles. The actual distance which can be covered is of course mainly a question of electric power.

The fact that the cable companies, which have never one of them adopted the Marconi system, have approved the Lodge-Muirhead system and are installing it on their cable ships is a splendid testimonial for the new method.

The telegraphic experts have not been satisfied with the filing-tube coherer used by Mr. Marconi. At every Marconi station it is customary to have on hand some thirty or forty of these tubes, as they have a mysterious habit of getting out of order, and it is impossible often to get them to receive signals at all. Possibly the continuous tapping has something to do with the lack of reliability of the filing-tube coherer; we have seen that in the Lodge-Muirhead receiver no tapping action is necessary.

Sir Oliver Lodge and Dr. Muirhead believe that they have got a system which will work regularly and without a hitch in all weathers; the coherer employed is regular and simple in action and quite easy to adjust, for it can be taken to pieces in a few seconds and any defects can be easily removed.

It may be mentioned that the disk coherer prefers long and slow oscillations to the sharp discharges which other coherers require, and the former are more convenient to work, especially in long-distance transmission. It is so sensitive that a long stroke or dash of the Morse code reveals the actual rate of sparking by the slight quivering of the line. The record on the tape is strong and clear and quite equal to the best submarine cable working.

Among other new features in the Lodge-Muirhead system, mention should be made of an automatic device for short-circuiting the coherer when the vertical wire is switched on to the transmitter, which obviates the necessity of burying it in a sealed metal case. Another new feature is the application of an ordinary automatic signaling machine to the sender. so that the message can be delivered perfectly spaced from a perforated tape, as in the British post-office machines.

THE NEW AMERICAN-BUILT LINER "MINNESOTA."

The first to take the water of the two mammoth freight and passenger steamships that have been building for several years at the New London yards, is the "Minnesota," of which we present a very striking picture on the front page of this issue. Measured on the basis of maximum displacement at extreme load draft, she is the third largest steamship in the world, being exceeded only by the "Celtic" and "Cedric" of the White Star Line. This vessel, which has just been launched, and her sister ship, which is still upon the ways, have been built by the Eastern Shipbuilding Company, which was organized for the purpose of constructing them. It is a curious and certainly unprecedented fact that this company took the contract for two of the largest vessels in the world before it was in the possession of either a plant, or even of the ground on which to build them. After carefully considering all available sites, the present location, opposite New London, Conn., was chosen.

The dimensions of the new vessel are: Length over all, 630 feet; breadth, 73 feet 6 inches; molded depth from keel to upper deck, 56 feet. On a draft of 33 feet the displacement is 33,000 tons, and on a maximum draft of 36½ feet, to which the vessel can be loaded whenever the depth of our harbors will admit of it, the displacement will be 37,000 tons. As compared with the "Cedric," the new ship is 70 feet less in length and 18 inches less in beam, but the molded depth is greater by the height of one deck, the plating being carried up, throughout the whole length of the ship, to the upper deck, which extends without a break from stem to stern. Although the dimensions of the "Minnesota" are less than those of the "Cedric," the fact that she approaches within about 1,000 tons of that vessel in displacement, is to be attributed to the much greater fullness of the New London boat, her bow and stern being considerably bluffer.

The space occupied by machinery is the smallest practicable, so that space for cargo may be as large as possible. In order that cargo may be readily stowed, the ordinary type of hold pillar has been dispensed with, and large box-shaped columns are fitted, supporting heavy girders which run longitudinally under the transverse beams which carry the decks. These columns are widely spaced, and in some cases only one is fitted in a hold, whereas by the older method ten pillars would be required. A longitudinal bulkhead is fitted the whole length of the ship; this divides each hold into two separate compartments, and therefore the hatches are fitted in pairs, one to each hold. Some of the hatches are so large that bulky freight, such as a locomotive or freight car, or large marine or land boilers, can be lowered right down into the hold. Every hatch can be loaded or discharged simultaneously if desired.

The cargo-handling plant on this vessel is very complete, and designed so as to cut down the number of men to a minimum. Two winches and two booms are fitted to handle cargo at each hatch. The booms, 34 in number, are built of steel. Two heavy booms are fitted to lift weights of from 30 to 50 tons. The winches for cargo handling are 34 in number, all electrically operated. One hold in the ship is devoted to carrying frozen meat, and is completely insulated; its capacity being about 2,500 tons. The insulation is so arranged that ordinary cargo can be carried on return trip.

The arrangement of coal bunkers is a novel feature on this ship, and, like the construction of the center longitudinal bulkhead and girders, is a departure which, as far as we know, the Eastern Shipbuilding Company have been the first to make in an ocean vessel. The bunkers are located above the boilers; the ends of the bunkers are inclined in such a manner that the bulk of the coal will gravitate through chutes and be deposited on the firing platform. The capacity of the permanent bunker is over 4,000 tons, and a reserve bunker is fitted contiguous to the boiler room, having a capacity for about 2,000 tons of coal.

The "Minnesota" has 16 Niclausse water-tube boilers, having a working pressure of 260 pounds per square inch. They will supply steam to two main engines of the triple-expansion type, which are arranged side by side, working separate shafts. The propeller wheels are 20 feet in diameter, and revolve 78 times per minute. The horse power of the engines will be about 10,000, and they will drive the ship at a speed of about 14 knots per hour.

The imposing appearance of the "Minnesota" is well shown by our engraving, which is supposed to be taken from the deck of a harbor tug, when the ship is entering an eastern port. In order to emphasize the great height of the vessel above the water, she is supposed to be running light, and even in this condition there is nearly 20 feet of the hull submerged. To realize the great size of the ship, we herewith recapitulate the various decks, platforms, etc., from the keel to the topmost bridge. First there is the outer bottom of the ship; 6 feet above that is the inner bottom or floor; then within the molded or plated structure of the vessel are the orlop, lower, between, main, and upper decks. All of these decks are of steel plating, and the whole structure of the ship from the bottom to the upper deck is 56 feet in height, the upper deck running, as we have said, in an unbroken sweep the whole 630 feet length of the vessel. Above the upper deck are the promenade deck, the upper promenade deck, and the boat deck, this last being about 80 feet above the keel, while 8 feet above this, or 88 feet above the keel, is the captain's bridge. Now, since the vessel at her lightest draft draws 17 feet of water, the captain's bridge, when the vessel is running light, will be over 70 feet above the water, and the passengers on the topmost upper deck will be between 60 and 70 feet above the water. From this elevated platform, they will be able to look down upon the crests of the heaviest seas that are ever known in the Pacific, and the broad beam and great mass of the vessel will cause her movement to be slow and regular, so that none but the most sensitive passengers should ever be troubled with seasickness. The "Minnesota" and her sister ship will be engaged in the Pacific trade, running from the home port, Seattle, by way of Honolulu to Yokohama. The distance from Seattle to Honolulu, the first stopping point, is about 2,300 miles, and from Honolulu to Yokohama 3,500 miles.

Several interesting experiments have been carried out by the Austrian army to obtain reliable data relative to the possibility of disabling a balloon when floating in the air, by either rifle or gun fire. For the purpose of the experiments a balloon was anchored at the height of about 7,000 feet, and the gunners, kept in ignorance of the range, were then commanded to disable the balloon. The difficulty of hitting the balloon when in midair can be realized from the fact that the gunners fired twenty-two shots before the approximate range was found, and that it was not till the sixty-fourth round that the balloon was hit, and then only slightly. The small tear in the gas bag, however, was sufficient to cause the balloon to descend slowly.

First Land Wireless Newspaper.

The only daily newspaper in the world publishing "sure-enough" dispatches transmitted by wireless telegraph had its birth on March 25, at Avalon, Santa Catalina Island. The event is important in the history of journalism and marks the beginning of an epoch in the dissemination of news in isolated places. The name of the infant journal is The Wireless, appropriately so called on account of the method by which it receives the news of the busy world. The unique sheet begins its career in the shape of a three-column folio, the exact size of the pages being 11 by 8 inches. In this convenient form is crowded, in addition to the local news of Avalon, an epitome of the local and general news appearing simultaneously in The Los Angeles Times, thus giving the residents of the island and visitors to its lovely shores a comprehensive synopsis of all the principal news of the world, hours before the arrival of the steamer from the mainland with the Los Angeles morning paper.

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Correspondence.

Wanted—An Ink That Will Not Fade.

To the Editor of the SCIENTIFIC AMERICAN:

If some one will invent a permanent typewriter ink he will do the business world a great service and probably a good business stroke for himself. Aniline ink is apt to fade if exposed to light. A lot of typewritten matter was stored in a slightly damp vault for six months. On removal the paper and gall-ink signatures were in best of condition, but all trace of typewriting had disappeared. A letter book was wet with water (not chemicals) in extinguishing a fire. The signatures were all that remained of the hundred pages of correspondence. STENOGRAPHER.

Milwaukee, Wis., February 4, 1903.

Dust—Is it Dangerous?

To the Editor of the SCIENTIFIC AMERICAN:

When the maid chases the dust round the room with a feather duster, she might as well be throwing chips to the wind so far as any good can come from it. Our brooms are nearly as bad, for all the fine dust—the kind that does harm—goes up into the air and escapes the dust-pan, to come down again after quiet is restored. Carpet sweepers are a slight improvement, but they do not sweep clean; some carpets require the strength of a good man with a broom to get the dirt out of them. If this is true, there is a great field for the inventor to produce a sweeper that will be sanitary; it must swallow all the dust.

It is quite important to know what dust consists of to be able to judge as to how healthy it is, and for this purpose many analyses have been made, leaving out factory, grain thrashing machine, and country road dust. We will take ten liters of air for a basis; in the Boston City Hospital the number of living bacteria was found to be nearly 450, and of molds 225. In a model New York hospital, where everything is supposed to be clean, and all the attendants are thoroughly drilled to fully understand what the word *clean* means, 12 living germs settled on the disk, and after sweeping 226. In a New York tenement house carpeted living room, 75 living bacteria settled on the disk in an exposure of five minutes; after sweeping, 2,700, and mold settled on a plate or disk three and three-quarters inches in diameter.

Using the same basis for outdoor analyses, in ten liters of air in Central Park, N. Y., 500 were found; in downtown streets, 965, and where the street sweepers were at work 5,810 living germs were found in the small space of three and three-quarters of an inch in a five minutes' exposure. Certainly not very healthy air to breathe.

Just how unhealthy and bad such air is will be left for the reader to guess at. One-half a liter of air (about 30 cubic inches) is what a man takes in every time he breathes, and if of weak lungs, he takes less, but always enough of the dust-laden air that may contain one or more tubercle bacilli, which may pass the many guards nature provides to prevent it, and settle in his lungs. Consumption follows. Nearly one-fourth of all deaths are from consumption, principally distributed by dust. Diphtheria, smallpox, yellow fever, Asiatic cholera, typhoid fever, scarlatina, measles, pneumonia, erysipelas, blood poisoning, etc., are among the diseases often disseminated by invisible dust particles.

The expectoration of a consumptive may contain millions of germs. Falling on the sidewalk of a city, it is soon tracked over a large area and gradually mixed with the dust; the same on the street, especially on asphalt pavements, where each wheel acts as a millstone, grinding everything into the finest powder, to be raised by passing vehicles into the air and sent into thousands of healthy lungs.

These conditions are reversed when it rains; the disease germs are washed into the sewers, and rarely, if ever, get a chance to enter into the air again as dust; then why not imitate rain, and sprinkle the streets? There exists even among well-read people a notion that sprinkling of the streets is unhealthy. A clean street thoroughly sprinkled cannot be unhealthy, and a dirty street is certainly less dangerous to health in a state of mud than if the mud was converted into dust, to be carried into our systems, our houses, and our clothing.

City streets should be kept scrupulously clean by hand labor, preferable to machines, and thoroughly sprinkled from four to ten times a day, according to the amount of travel and the condition of the atmosphere. No street used for general traffic can be kept perfectly clean, that is an impossibility; then do the next best thing. A street cleaned once or twice a week cannot be very clean. A man with suitable tools, according to the pavement, should be given as much territory as he can cover from five to ten times a day, removing the droppings at once before they are ground into dust. A sprinkling wagon should keep it damp enough to keep the dust from rising; the wagon should also have a hose attachment, so that a man or boy can wash the dust from the sidewalks at least three times a day. Asphalt pavements require more sprinkling than other pavements, but it is not necessary that they be constantly wet, for the reason that after sprinkling, the dust and dirt form a paste that will not again rise in dust, even if the pavement looks perfectly dry, until the wheels have again pulverized it into powder. Horses do not slip on wet pavements when they are *clean*; the dirt makes them slippery. The first few drops of fine rain or dew sometimes cause trouble, but the heavier the rain or sprinkling (from cart), the better on asphalt. If asphalt pavements contain the proper ingredients to effectually shed water, no injury can come from any amount of rain or sprinkling, in fact the more the better; if, however, any water is absorbed, as is shown by a spot that does not dry at once when the rain stops, such spots soon become holes, especially in fall, when frost gets at them.

Municipal corporations should furnish all the water free, from a sanitary point of view, to anyone who is willing to hold a hose or employ a cart to sprinkle walks or streets. Whenever a village grows out of barbarity into civilization, they close their wells, build waterworks, and employ sprinkling wagons—drink pure water and stop eating dust.

Country air may contain only 200 particles of dust per cubic centimeter, while that of large cities may run up to 150,000, and in tenement houses as high as 1,000,000. These particles consist of sand, soot, cotton fiber, pollen, fine hair, pulverized excreta of animals, parts of seeds, bacteria, molds, etc. Most of these of course are perfectly harmless, except when they are too numerous and irritate the respiratory organs or contain the live germs of contagious diseases.

Our modes of ventilation, so far as dust is concerned, are as crude as our way of chasing the dust from one place to another with dusters, instead of catching it with damp cloths and damp brooms. The only pure air is so far above us as to be practically out of reach, but some day there will be a trust organized to supply dwellings with *pure* air, as we now imagine we enjoy pure water.

C. D. ZIMMERMAN.

Buffalo, N. Y.

Does Water Extinguish or Feed a Fire?

To the Editor of the SCIENTIFIC AMERICAN:

It seems to me about time that the practice of using water in trying to extinguish fire in buildings should cease. Why use an element that assists combustion, in trying to destroy combustion? In theory, water destroys fire very well, in practice it does not, owing of course to the impossibility or reaching the flame, thus feeding the same and adding to the danger. What a magnificent chance for inventors to bring out something practical to destroy fire, and also a way to apply same, so it could be used by anyone, and not require an expert. F. N. DAVIS.

[The proposition of our esteemed correspondent is interesting, and if feasible should lead to valuable results. We are not able, however, to assent to some of the positions of his letter. We are aware that there is a popular impression that water thrown upon a fire assists the conflagration under certain conditions. We, however, are also aware that chemists do not consider this to be a fact. Water cannot feed a flame unless it is separated into its constituent gases, oxygen and hydrogen. Water is the most destructive to fire of any liquid which can be commanded in sufficient quantities for such a use, since it contains all the oxygen it can hold. The question, then, resolves itself into this: Can water discharged upon a fire be separated into gases so as to feed the flame? The probabilities are decidedly against this. Water is every day separated into its constituent gases in all our cities in the making of water gas, as it is called, so that the problem of accomplishing this is well understood. For the beginning of dissociation a temperature of 2,200 deg. F. is required. The dissociation is complete at 4,500 deg. F. It is very safe to say that these temperatures are not possible in the open air. The blast furnace will give a temperature of 3,300 deg. F. In a confined space, as in a water gas plant, anthracite coal under a blast of air will pass the temperature required for dissociation; but with nothing to prevent the escape of the steam there is no reason to suppose that it can be made hot enough to dissociate it, and so there is no reason to believe that any open-air conflagration was ever fed by playing water upon it.

The only substance besides water to be used for putting out a fire is carbon dioxide, a gas most efficient for this purpose. It is the basis of all chemical fire extinguishers. The difficulty in its use is to place it where alone it can be of service, at the very base of the flame. The strong ascending currents of hot air divert the stream of carbonic acid gas, and it does not easily accomplish its object.—ED.]

Suggestions Regarding the Metric System.

To the Editor of the SCIENTIFIC AMERICAN:

The objection to the metric system of measurement for common use, is that its subdivisions are odd and do not give the even or binary divisions of quarters, eighths, sixteenths, etc. The division of the centimeter into ten equal millimeters is for many purposes entirely unsuitable.

It is precisely similar to our subsidiary coins. In strict adherence to the decimal system, the next denomination below the dollar is the dime; but if we had no intermediate coins, we should find the decimal system of currency very inconvenient for practical purposes. The half and quarter dollar coins are very necessary; and although they are entirely foreign to the decimal system, their use detracts nothing whatever from it.

The metric system possesses all the advantages of our decimal system of currency; but in order to make it available for general use, it should be modified in the same way; that is, to divide the centimeter into halves, quarters, eighths, etc., same as we now divide the inch. The 1-32 centimeter is a little smaller than our 1-64 inch. This subdivision of the centimeter will correspond with the halves, quarters, etc., of the decimeter, and also of the meter.

For some uses, the millimeter divisions are necessary, and rules should be made with the binary divisions of the centimeter on one side or edge, and the millimeter on the other. Rules three and six decimeters long would be nearly the same length as our one and two foot rules respectively.

This slight modification would make the metric scale as convenient and acceptable as our foot rule, while retaining all the advantages of the metric system. LEVI ORSER.

Galveston, Tex., March 19, 1903.

The Duodecimal System.

To the Editor of the SCIENTIFIC AMERICAN:

Regarding the suggested "duodecimalization" of our arithmetic and weights and measures proposed by Mr. Reeves, I wish to state that few practical men have ever been guilty of proposing to substitute a duodecimal system of weights and measures without a similar change in our arithmetic. The inconvenience in calculation would be very great, and no compensating advantages would be felt unless our arithmetic were changed. To abandon our decimal system of arithmetic would be as impracticable as to adopt Volapuk. Our decimal arithmetic is like our language, a universal inheritance of the race; and the metric system is the further extension of the decimal plan already applied to our arithmetic and our coinage. The metric system is evolutionary; a duodecimal system would be revolutionary.

James Watt, the inventor of the steam engine, proposed the *decimal* division of the pound; Thomas Jefferson suggested a *decimal* system of weights and measures; John Quincy Adams favored the *decimal* base. Abbe Gabriel Mouton (in 1670) first proposed a universal *decimal* system. Note that all the proposals of the great practical metrologists have been for the *decimal* system. The unanimity of this point resulted in the establishment of the metric system, conforming to our arithmetic and our coinage. This system involves neither the introduction of strange numerical symbols nor the readjustment of our arithmetic as would a duodecimal system. The adoption of a duodecimal system would multiply the inconvenience of learning weights and measures, whereas the metric system would simplify it, because no special arithmetic is required, and our computations are cut short about fifty per cent, and our arithmetics could be reduced to two-thirds their present size by omitting the present sets of tables.

When we have a duodecimal arithmetic, it will be time to talk of changing our coinage, and our arithmetic, and our weights and measures to that system. The present movement for the adoption of a metric system would result in a maximum gain with a minimum of inconvenience. The simplicity of a single ratio in all commercial calculations, accounts, measures, and numbers is so obvious as to appeal to every one who thinks. Lord Kelvin states that instead of involving confusion during the transition, the reverse happened in his own establishment; that the adoption of the decimal system was a convenience from the very first.

Our country has been very slow in accepting the metric system, largely through ignorance of the metric system, but partly because of the inconvenience of making the change. Surely it would be folly to expect that we would accept a reform which is a hundredfold more sweeping, and the results of which are doubtful. Why not accept first a reform the practical value of which has been tested in all civilized countries, and proven beyond doubt by the forty nations who have already adopted the metric system?

January 21, 1903. N. Y. HUBBARD.

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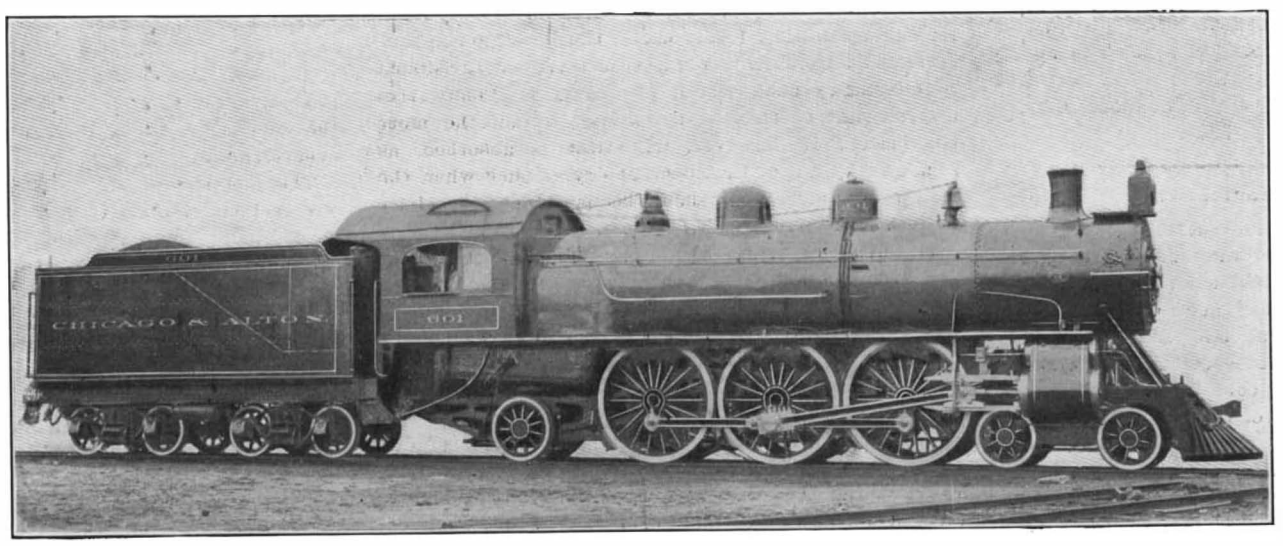
THE MOST POWERFUL EXPRESS PASSENGER LOCOMOTIVE.

The Scientific American has duly illustrated and described, from time to time, the most powerful passenger locomotive as each engine, which was qualified to bear this title, has made its appearance. At present the largest and most powerful express engine in existence is the one shown in the accompanying illustration, which has just been built by the Baldwin Locomotive Works for the Chicago & Alton Railway. This and a sister engine have been built especially for the heavy passenger excursion trains which will be run in connection with the St. Louis Exposition.

With a view to determining the best type of engine for this particular service, the Chicago & Alton Railway borrowed and tested some of the most powerful passenger engines in the United States. They found that, big as some of these were, they were still not equal to the heavy exactions of the proposed service, and accordingly a design of an engine heavier and more powerful than any of its kind in existence was drawn up. Hence, it will be seen that the *raison d'etre* of these enormous engines, so far from being any foolish desire to build the biggest engines in the world, is to be found in the extraordinary exigencies of the traffic which the road will have to handle when the Exposition opens.

The duty of these engines will be to haul trains made up of twelve passenger cars, and weighing about 600 tons exclusive of passengers and baggage. Such a train will accommodate 760 people, whose aggregate weight would not be less than 57 tons, and estimating their baggage at 15 tons, the total weight of the train behind the engine will be 675 tons. Such a train will have to be hauled 110½ miles in two and one-half hours, making two stops and three slowdowns for railway crossings. This will reduce the actual running time to two hours and twenty-four minutes, and necessitate an average running speed of 46 miles per hour.

The most powerful locomotive used in the preliminary test was a Prairie type engine, with six-coupled wheels, 20½ x 28-inch cylinders, 80-inch drivers, 33,043 square feet of heating surface, and 34,990 pounds tractive power. From the results obtained it was decided that to do the work an engine fifteen per cent more powerful than this was needed, and accordingly the present mammoth locomotives were built. The cylinders are 22 inches in diameter by 28 inches stroke; the driving wheels are 80 inches in diameter, and the working steam pressure is 220 pounds to the square inch. The engine is carried on twelve wheels, a forward truck, six connected driving wheels, and a trailer beneath the firebox. The total weight on the driving wheels is 141,700 pounds. On the front truck the weight is 36,300 pounds, and on the trailing wheels 41,500 pounds, the total weight of engine being 219,500 pounds, and the total weight of the engine and tender is about 374,000 pounds. The tender, which has a capacity of 8,400 gallons of water and 9 tons of coal, is the largest yet built by the Baldwin Company. The boiler is of the straight type and 70 inches in diameter, with 328 2¼-inch tubes 20 feet in length. The firebox is 9 feet long by 6 feet wide, 6 feet deep at the front, and 5 feet, 4 inches deep at the back. There are 202 square feet of heating surface in the firebox, 3,848 square feet in the tubes, and 28 square feet in the firebrick tubes, making a total of 4,078 square feet of heating surface, or 500 square feet more than the New York Central express engines possess. The grate area is 54 square feet. A remarkable feature, which in itself is illustrative of the great size of these engines, is the smokebox, which is no less than 8 feet, 5 inches in length. The tractive effort is 31,600 pounds; that is, if the tender drawbar were attached to a dynamometer, it would register over 15 tons.



THE MOST POWERFUL EXPRESS PASSENGER LOCOMOTIVE.
Cylinders, 22 x 28-inch; driving wheels, 80-inch; heating surface, 4,078 square feet; weight, 219,500 pounds.

A NEW ELECTRICAL FIRE ENGINE.

BY A. FREDERICK COLLINS.

In view of the fact that electricity has invaded the domain of every art, science, and industry, it seems not a little strange that the electric fire engine has but recently been invented. At Rouen, France, not long since, some public tests of this type of engine were made, and it proved so eminently satisfactory that this continental municipality at once adopted it.

This new system of fire extinguishers offers among others the following advantages: (*a*) in three or four minutes after reaching a fire it is ready to operate; (*b*) it is extremely light and therefore good time may be made; (*c*) no coal or fire or water is required for raising steam; (*d*) there is an absence of noise, cinders, heat, smoke, etc; (*e*) there is no boiler to clean and no danger from explosion; (*f*) it is less expensive in its initial cost than the steam fire engine and is cheaper to maintain; and (*g*) it requires practically no attention when in operation.

The first electric fire engine constructed at Rouen is shown in the accompanying engraving and consists of an eight horse power electric motor coupled direct to a pump, both of which are on the same plane; the motor makes about 2,000 revolutions per minute and is wound for a 525-volt direct current.

When the electric fire engine is in action, the current is tapped by means of a movable bamboo perch, one end of which is fastened to the truck carrying the equipment and the opposite end is simply poised on one of the overhead trolley wires, or at night contact may be made with the electric lighting cables.

The feed wire is rolled on a reel above the motor, as shown; the circuit is completed by a similarly arranged wire wound on an adjacent reel; the free end of this wire terminates in a block of cast-iron placed on one of the rails of the street railway tracks.

AN ELECTRIC FIRE ENGINE.

These are the principal parts of the equipment, but there are some other necessary devices including a general interrupter, two circuit breakers, a reversing commutator and other accessories. The apparatus complete is arranged on a two-wheeled, one-horse cart.

The hose is carried on a separate cart coupled to the electric fire engine, and the reel carries 660 feet of hose. The reels upon which the conducting wires are wound carry approximately 660 feet of rubber-insulated wire, so that connection may be effected without difficulty, and it is obvious that water can be projected to a distance of 1,320 feet from the point at which electrical connection is made.

The total weight of the complete apparatus is 2,288 pounds, including that of the two firemen seated on the engine, against 9,760 pounds of a standard La France steam fire engine, such as is called for by the specifications of the Borough of Manhattan (New York city); of course an allowance must be made for the difference in horse power between the Rouen electric fire engine and the Manhattan steam engine, since the former is only eight horse power and the latter is twenty-two horse power, but the ratio of increase in weight per horse power is very small in the electric fire engine.

The dimensions of the one under consideration are as follows: length, 3 feet, 3½ inches; width, 1 foot 8 inches; height, 1 foot, 3 inches. Compared with these figures, the dimensions of a steam fire engine seem abnormally large, viz.: the boiler is 64 inches in height, and 30 inches in diameter.

With water under ordinary pressure from a hydrant, a stream was forced to a height of 145 feet, whereas the normal hydrant pressure would have projected the water to a height of only 49 feet. In the electric fire engine a centrifugal pump is employed; the diameter of the nozzle, which ejected 77 gallons of water per minute, was 7-10 of an inch; the diameter of the hose was 1¾ inches.

To improve the electric fire engine by operating not only the pumps but the traction as well by electric motors would seem but a short step. This would do away, not only with the steam engine, but the horse as well. Capt. John Kenlon, of engine 72, Manhattan, offered a valuable suggestion when he said to the writer, recently, that municipalities in giving franchises to street railway and electric light companies should stipulate in the contract that leads should be run from their circuits to every fire plug on the route. Then electric fire engines could be adopted, the pumps of which could be operated by merely slipping a spring jack into contact with the leads terminating in some portion of the fire plug, while the traction could be obtained by means of a motor and storage battery, just as with automobile trucks.

One of the most troublesome duties attendant upon a steam fire engine is that of supplying it with coal. If the fire is of longer duration than thirty minutes, coal must be had from some supply depot, and this is not only often difficult to obtain but it is very expensive as well. This, with the cost of feeding the three horses required to draw the heavy engine, is excessive, and can be reduced nearly three-fourths when the electric fire engine takes the place of the steam engine.

In this age of electricity there is no doubt but that the new electric method will speedily supplant the old steam engine system; just as the steam fire engine took the place of the older hand pump.

After prolonged negotiations the British Postal Department has sanctioned the connection of Marconi's wireless telegraph station at Poldhu, Cornwall, with the nearest postal telegraph station, so that now continuous communication is possible between the Marconi and State systems. The government had previously offered the Marconi company a private wire from Poldhu to London, but this was insufficient, as with the development of the system it will be necessary to have telegraph wires communicating between the wireless stations and various important provincial centers. This is the first official recognition by the British postoffice of Marconi's invention, and it is anticipated that this concession will in a short time be extended so as to provide the wireless telegraph system with the same advantages already accruing to the cable companies in the transmission of messages from London to Canada and this country.

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The Latest About the Edison Battery.

The long delay in the appearance upon the market of the widely heralded Edison storage battery has given many persons an impression that in the development of the invention Mr. Edison ran up against some "snags." What the difficulties met with have been has so far remained dark, but some recent utterances of the inventor and a number of recently issued patents throw some light on this subject.

In the first place, the nominal capacity has been reduced from that given in the first description of the new cell by Dr. Kennelly before the American Institute of Electrical Engineers about two years ago, and with the present rating the Edison battery is hardly equal to the best lead batteries as regards specific capacity. As the amount of energy which a certain quantity of the active material is capable of storing is invariable, it must be inferred that it was found expedient to reduce the proportion of active material to the total weight of the cell. This inference is confirmed by one of the patents referred to, in which it is stated that the oxidizable element of the cell swells considerably during the process of charging, resulting in the bulging out of the walls of the sheet steel pockets which retain the active material. This necessitated a greater space between adjacent plates, which space had to be filled with electrolyte, thus adding to the weight. Possibly the same action necessitated heavier retaining walls. The present invention aims to overcome this difficulty, but it evidently accomplishes the object only in part, for, although it may not be necessary to space the plates as widely with concave pocket walls as with straight walls, the concave walled pockets will hold less active material, which would seem to reduce the capacity.

The subject of the other patent is a new admixture of conducting material for the active material. Originally fine flake graphite was used for this purpose. It is now proposed to mix the finely divided iron with mercury and copper, which is claimed to have the same effect on the conductivity of the active material as the graphite, and in addition keeps up the voltage toward the end of the discharge.—The Horseless Age.

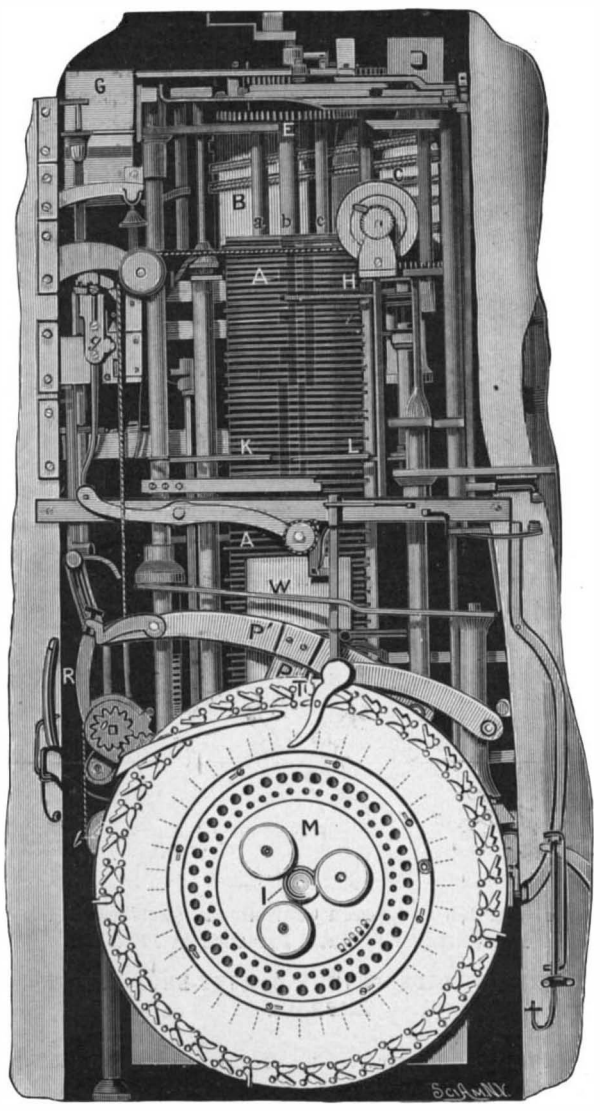
New Statistics of the Weight of the Human Brain.

Prof. Marchand, of Marburg, publishes the statistics of the largest number of brain weights so far collected. His analysis includes 1,169 cases. The average weight of the brain at the birth of a male child, according to Prof. Marchand, is 360 grammes; of that of a female child 353 grammes. He concludes that the lesser weight of a woman's brain is not alone dependent on her smaller stature, for a comparison of both sexes of the same height shows that the male brain is invariably heavier. In a growing child, until it reaches a height of 70 centimeters, the brain weight increases proportionately with the body length, regardless of age or sex. After this the male brain begins to outstrip the female. The maximum weight is attained about the twentieth year, at which age that of the male averages about 1,400 grammes. The female maximum is usually reached about the seventeenth year, when the average is 1,275 grammes.

A new graving dock is to be built at Belfast, Ireland, at a cost of $1,500,000. It will be 750 feet long, 96 feet wide at the entrance, and 100 feet wide at the bottom. The depth will be 32 feet from the blocks to ordinary high-water level, and some 4 feet 6 inches will be allowed for the blocks.

THE JAQUET-DROZ ANDROIDS.

The famous Jaquet-Droz automatons, created in the eighteenth century by a father and son of that name, may have been heard of but probably have never been seen by or described to few, if any, of our readers.



Interior Mechanism of the Writer.

We give, therefore, in this issue, a brief general description of the mechanism of one of the androids, which description we have succeeded in obtaining from their present owner, Mr. Henri Martin, of Dresden, Germany. In the current issue of the SUPPLEMENT will be found a more general description of the androids and of the wonderful feats they performed.

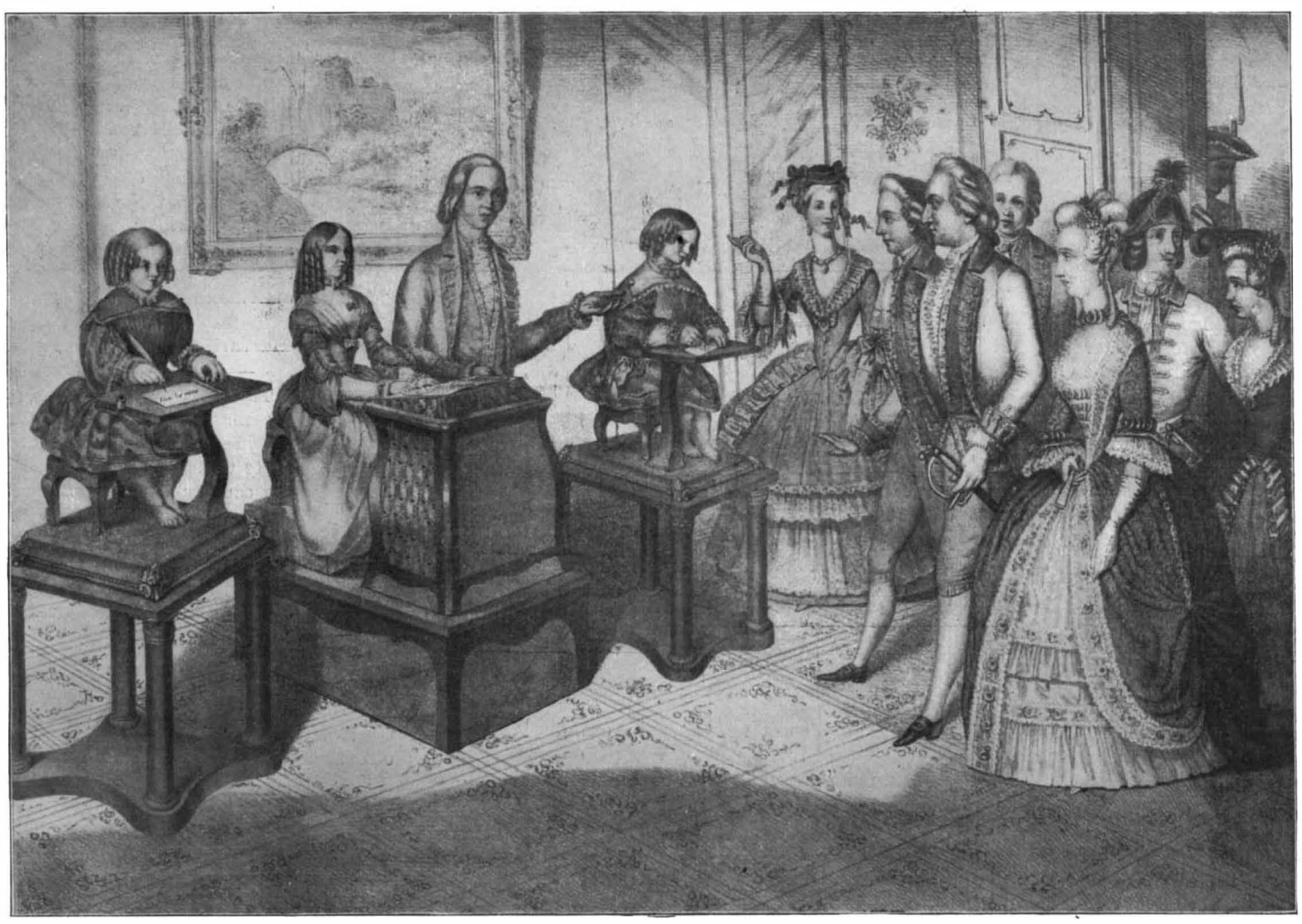
The mechanism, as shown in the cut, is that of the "Writer," built by Jaquet-Droz the elder. The engraving presents a view of the same when the automaton is opened at the back. It is actuated by two movements, an upper one and a lower one. The latter constitutes, as it were, the thinking element, inasmuch as it makes the desired letters and all the necessary preparations, whereupon the upper movement executes the letters proper. Both movements are connected in such a manner that they never operate simultaneously, but that one arrests the other, if it is to act itself.

The barrel, *B*, of the upper movement is connected with the fusee, *C*, by means of a chain, in such a way that, during the winding, the chain unwinds from the former onto the fusee, thus tightening the spring in the drum and causing the movement to start. The motion of the barrel, *B*, is transmitted by means of the gear wheel, *E*, mounted upon the axle, *b*, of the letter cylinder, *A*. At *G*, is the regulator, a fly, which is governed by special stops. From this fly a stop extends downward to the fly of the lower movement in such a manner that when the upper one is free, the lower one is arrested, and *vice versa*.

We will next consider the mechanism of the lower movement. On the arbor, *I*, is mounted the letter disk *M*, consisting of three annular plates connected to each other. Of these plates only the exterior one is visible. The one situated next to this is toothed, while the third one has recesses for the inclined planes. The movement of the disks is simultaneous. The pitch of the inclined planes governs the height to which the driving cam, *P*, is lifted for each letter, and is, therefore, different in each case.

The cam, *P*, is attached to the lever, *P'*. At the end of *P'* is the arm, *R*, to which a double chain is made fast. This chain is led over the pulley, *l*, and around the arbor, *I*, in such a way that it and a similar chain, coming from the other side, cause the loose arbor, *I*, to revolve according as the lever, *P'*, with its cam *P*, is lifted by means of the inclined planes. From this it follows that *I* must make a small or large portion of a whole revolution with each letter. The regulation of these revolutions is accomplished by the teeth, *T*, around the edge of disk, *M*, each pair of which corresponds to a letter or punctuation mark.

Let us now turn to the upper movement. This causes, when the lower one stops, a complete revolution of the wheel, *E*. With this wheel are connected the three rods, *a*, *b*, *c*, so that *b* turns on its axis when *E* revolves. On *b* are mounted 120 eccentric disks, which are maintained in their position by the rods *a* and *c*, in such a manner that the whole eccentric column may be moved up and down on the rods, *a*, *b*, *c*, but at the same time follows the revolution of the rod *b*, on its axis. Each of these disks is specially shaped for a letter corresponding to it. The three levers, *H*, *K*, *L*, bear upon these disks and transmit the motion obtained from them to the right arm and hand. Their motion is a four-fold one: (1) horizontal, moving forward and backward; (2) horizontal, moving right and left; (3) oblique and also arched, resulting from a combination of the first two; and (4) vertical motion. The shapes of the eccentrics have been determined by laborious trials. From the above it will be seen that three disks are necessary to trace one letter. During one revolution the three levers work simultaneously or interruptedly as the eccentrics direct them. The eccentrics are, because of their connection with the crank, through the inclined planes, and because of their perfect adjustment, lifted so accurately in line with the three levers that the latter,



The Writer. The Musician. The Draughtsman.

THE AUTOMATONS OF JAQUET-DROZ EXHIBITED AT THE COURT OF LOUIS XV.—From an old lithograph.

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set in jewels, give as a result the desired character.

The writing android can write any sentence, but the proper changes must first be made in the disk *M*, which requires about two hours' work. The actual penning of the sentence of about 40 letters, no matter what text, is accomplished by the android in three or four minutes.

The "Writer" dips the pen in the ink, squirts out the superfluous ink, moves its head and eyes, distinguishes between the down strokes and hair strokes in the letters, and forms them nicely rounded.

The mechanism of the "Draughtsman" is constructed on the same plan, but naturally he draws only certain things. When exhibited before Louis XV., of France, he drew the King's portrait, adorned with a laurel wreath, a gallantry which so impressed the King that he decorated Droz with an order. Shown at the British Court, the "Draughtsman" astonished the royal audience by sketching the portraits of George III., and his wife, Charlotte, on the same piece of paper. He also draws a small dog, under which he writes the words "Mon Toutou," and a picture of Cupid seated in a triumphal carriage drawn by a butterfly. All these objects the little android sketches with the ease of a live person. Now and then, when his drawing has advanced somewhat, he holds the pencil aside, inspects his work at a distance, moving his head and eyes, blows the graphite dust from the paper, and then resumes his work, doing the shading etc., perfectly.

With the "Pianist" we also find the eccentric system. The android, apparently a young girl, twelve or thirteen years of age, is seated at the "Clavinos"—a spinet-like instrument—and plays entirely by the pressure of the fingers, which is essential; hence it is not in itself a music box. It, too, plays only certain pieces. The mechanism in this android also regulates the movements of the body, such as a graceful bow, motion of the head and eyes, heaving of the chest in breathing, etc.

The "Draughtsman" and the "Musician" were constructed by Jaquet-Droz, the younger.

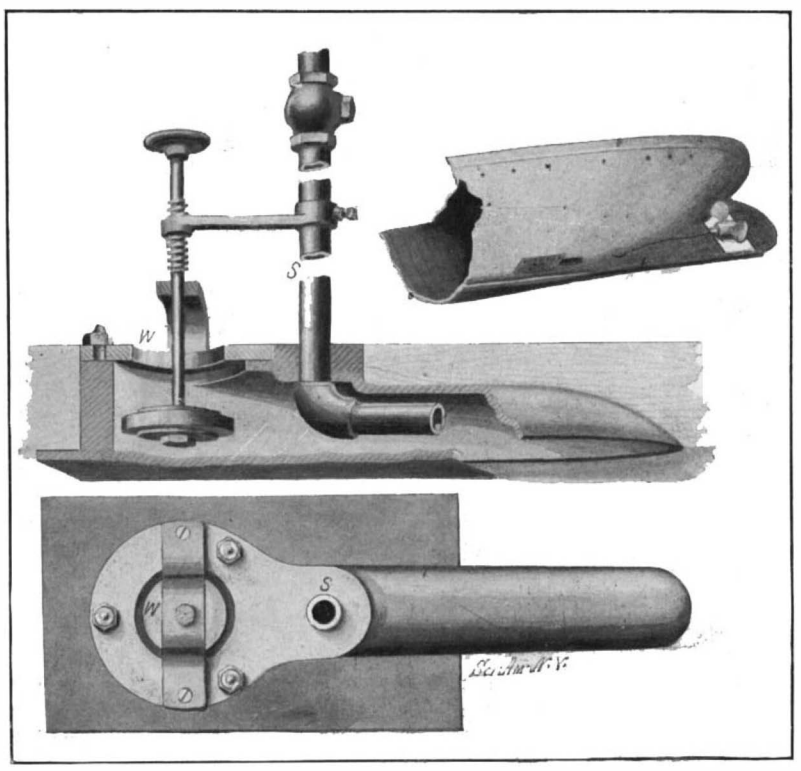
The history of the three androids is an interesting one. Accompanied by an English impresario, Jaquet-Droz, the younger, also showed the androids in Spain. The Spanish King evinced great interest in them, and received the artist with marked attention. But the populace, bigoted and superstitious, did not take kindly to the androids. Jaquet-Droz was thrown in the Inquisition dungeon, and although he was soon set free, his British manager, who had caused all the trouble by representing the matter in a supernatural light, claimed the automatons as his property. Jaquet-Droz returned to Switzerland, thoroughly disgusted. A French nobleman bought the androids, but could not make them work, and for many years they stood in the castle of Mattignon, near Bayonne, because the owner had died on a voyage to America, and no one knew of them. After changing hands various times they came into the possession of the family of the present owner, where they have remained for the last one hundred years. They are in as good condition as they were when created by their makers one hundred and fifty years ago.

Despite the high development of the mechanical arts, these androids have not been equaled up to the present time. They are unique, and art experts have estimated their value at 150,000 marks ($38,000).

APPARATUS FOR DISCHARGING BILGE WATER FROM SHIPS.

The accompanying engravings show a simple apparatus whereby the foul water which collects in the bilge of a ship may be easily and effectually discharged. The apparatus is the invention of Mr. Joseph R. Jobin, care of L. E. Meyer, 302 Chestnut Street, St. Louis, Mo. As illustrated, the water is discharged through a chamber formed by a casing let into the bottom of the hull of the vessel. This casing is provided with a spout or discharge tube projecting rearwardly and lying flush with the face of the hull. The upper wall of the casing is provided with an opening communicating with the hold of the vessel, but is normally closed by a valve *W*. A steam pipe *S* enters the chamber at a point to the rear of this valve. A jet tube is coupled to the end of the steam pipe, and projects into the discharge pipe.

To discharge the bilge water from the vessel, steam is first admitted to the jet tube, and then the valve *W* is opened. The steam in escaping from the jet tube creates a vacuum in the discharge pipe and chamber. This causes the water in the hold to be sucked out into the chamber, and pass out with the steam through the discharge pipe. If it be desired to scuttle the ship, this can be easily done by opening the bilge-water valve without admitting steam to the chamber. Water will then quickly flow into the vessel. The simplicity of the whole apparatus is readily apparent. It requires no attention, since it comprises no moving parts to get out of order. It will be noted that the valve *W* has a very strong construction, whereby it may be firmly seated to prevent leakage.



APPARATUS FOR DISCHARGING BILGE WATER FROM SHIPS.

Nova Geminorum Before Its Discovery.

On March 27, 1903, a cable message was received from Prof. Kreutz, of Kiel, stating that an object which was probably a new star, but was possibly a variable, had been discovered by Prof. Turner. Also, that on March 16 it was of the magnitude 8.0, while on February 16, it had not been seen (presumably on a photograph). Its apparent place was R. A. 6h. 37m. 48s., Dec. + 30 deg. 3 min. The grant from the Carnegie Institution permitted an examination to be made of the early photographs of the Henry Draper Memorial, and furnished the history of this object from its first appearance to the present time. An excellent photograph of the region, taken 1903, March 1d. 15h. 3m., G.M.T., showed stars of the magnitude 11.9, but no trace of the Nova was visible. A similar result was found from sixty-seven plates, the first taken March 3, 1890, the last on February 28, 1903, although nearly all of these plates showed stars fainter than the twelfth magnitude. One or more of these photographs were taken on each intermediate year. It did not therefore seem necessary to examine the other early plates of this region, a hundred or more in number. A plate, taken 1903, March 2d. 13h. 19m., showed stars of the ninth magnitude, but no trace of the Nova. The evenings of March 3, 4, and 5, were cloudy, but on a plate, taken March 6d. 14h. 28m., an object of the magnitude 5.08 appears in the given place. Plates taken on several later nights showed that the magnitude was gradually diminishing.

The photograph of March 6 has especial value since so far as is known, it contains the first photograph of the Nova. The image is on the very edge of the plate, and accordingly was compared with fifteen other stars at about the same distance from the center of the plate. The Nova was compared twice with each star by each observer. The value of the grade was much larger than usual, and equaled 0.21 and 0.33 for the two observers. The mean result for all was magnitude 5.08, with an average deviation, for the separate stars, of ± 0.26.

The evening of March 27 was cloudy and also the early part of March 28. One plate, however, taken on the latter date gave the magnitude, 8.34. Several photographs were taken on March 29, 31, and April 1, and gave the mean magnitudes, 8.24, 8.24, and 8.25. It is probable that the fainter stars are really fainter than these magnitudes indicate, but the latter will serve to determine the relative changes in the Nova as it grows fainter, and thus render the results of different observers comparable. All the magnitudes can later be reduced to an absolute scale. They also serve to compare the faintest stars shown on early plates. Thus, the photograph taken March 1, 1903, shows star t, and also stars at least a tenth of a magnitude fainter. Star u does not appear. Hence this plate shows stars of the magnitude 11.9 and brighter.

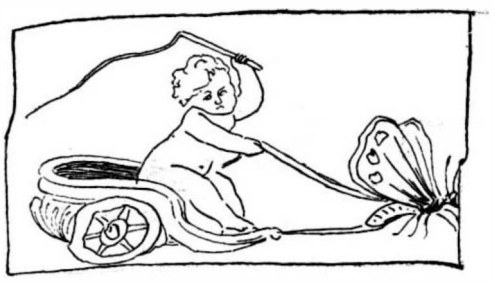
A plate taken March 25 is of interest since it was taken with an objective prism, and accordingly shows the spectra of the Nova and of the adjacent stars. Six bright lines are shown in the spectrum of the Nova, whose designations. assumed wave-lengths, and intensities, calling the intensity of the line $H\gamma$, 10, are as follows: $H\zeta$, 3889, 1; $H\varepsilon$. 3970, 3; $H\delta$, 4102, 8; $H\gamma$, 4341; 10—, 4643, 11; $H\beta$, 4862, 9. From this it appears that the spectrum resembles that of Nova Sagittarii on April 19, 1898. No dark lines are visible, but this is perhaps owing to the small dispersion.

The same lines, and having nearly the same intensities, appeared on similar photographs taken on March 29, 31, and April 1. They also showed the additional nebula line, 5003, which has the intensity 2 or 3, and is certainly brighter than $H\zeta$. This line does not appear on the plate taken March 25, and indicates the first step in the change into a gaseous nebula. Three additional bright lines were detected in the later photographs, whose estimated wave lengths are about 4176, 4240, and 4462.

In the other new stars the appearance of line 5003 was followed by the diminution in intensity of the line $H\beta$, and the appearance and rapid increase in the nebula line, near $H\zeta$, which finally became the strongest line in the spectrum.

A most important question in connection with the appearance of new stars is, whether such objects can come and go without detection by astronomers. Since the Henry Draper Memorial was established, nine new stars have been discovered. Six of them, Nova Persei No. 1, Nova Normae, Nova Carinae No. 2, Nova Centauri, Nova Sagittarii, and Nova Aquilae, were found in the regular examination of the Draper Memorial photographs, and probably all of them would otherwise have escaped detection. Two, Nova Aurigae and Nova Persei No. 2, were bright, and were found visually by Dr. Anderson. The first of these might have escaped detection here, although numerous early charts were obtained which showed that it was visible to the naked eye during seven weeks before its discovery. The spectrum of Turner's Nova is so conspicuous on the plate taken on March 25, that when this plate was developed and examined it would doubtless have been found on it here, but for the prompt discovery and announcement by Prof. Turner.

Edward C. Pickering.
Harvard College Observatory.



Sketch of Cupid Drawn by a Butterfly.

King George III. and Queen Charlotte, as Sketched by the Draughtsman in Their Presence in 1774.

DRAWINGS MADE BY THE JAQUET-DROZ ARTIST ANDROID.

The steady development of the coastwise passenger trade of the United States is shown by the steady growth of the various fleets that run between the leading ports of the country. This is particularly noticeable in the Southern trade and that to the West Indies. During the present month a new American-built passenger steamer the "Monroe" will take her place on the daily service of the Old Dominion Line between New York and Norfolk. She is a steel ship 366 feet in length and 46 feet in beam. She is driven by triple-expansion engines of 4,500 horse power at a speed of 16 knots per hour, and has accommodations for 150 first-class and 76 second-class passengers.

France is no longer the only source for the supply of absinthe. In some sections of Wisconsin the liqueur is distilled not only for American consumption, but also for export to Europe.

The Braun system of wireless telegraphy has been successfully tested in holding communication between stations and moving trains.

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New German High-Speed Trains.

It has been decided to increase the speed of the trains of the Prussian State Railroads running between Hamburg, Hanover, and Berlin. This decision is the outcome of the experiments with the high-speed electric locomotives upon the Berlin-Zossen military railroad. The new high-speed trains are to be propelled by steam, as the Berlin-Zossen experiments proved that heavy electrical trains exercised a great wear and tear upon the rails. All the leading locomotive builders were invited by the State to submit designs and specifications for high-speed steam locomotives. Of the competitive designs submitted, five have been selected, and the firms who prepared these respective projects have again been requested to study further the problem, and to submit fresh designs for steam locomotives capable of attaining a speed of 100 miles per hour with a light load, and 90 miles an hour in ordinary traffic. The five locomotives to be built for the purpose will be submitted to exacting and exhaustive tests to ascertain precisely to what extent they coincide with the State's requirements in the direction of high speed. The construction of these new engines will mark an important development in railroad transit in Germany. Simultaneously the electric firms are endeavoring to overcome the objections, and to eliminate the inherent defects, which characterized the electric locomotives in the Berlin-Zossen tests, so that very keen competition is now rife between the steam and electric locomotive builders, and some interesting comparative data relative to the two systems of train propulsion will soon be available.

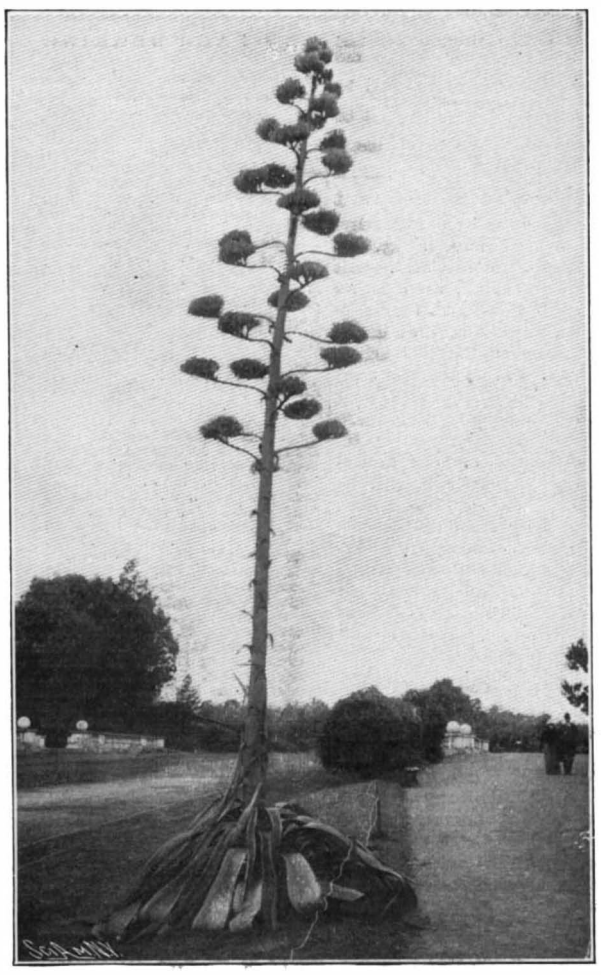
The high-speed steam railway competition, which was inaugurated about a year ago by the German Society of Mechanical Engineers, has resulted in no prizes being awarded; only five of the plans submitted being given honorable mention. It is now under consideration to submit a closed competition between the five more successful engineers under specifications of a more practical nature. In last year's competition it was specified that the steam locomotives were to be designed to be powerful enough, and to be capable, with the cars, of withstanding the high speed of 90 miles per hour, a train speed which has been thoroughly demonstrated both here and abroad to be far beyond the limits of possibility imposed by the track and road-bed conditions of the best railway lines.

It is announced that Stanley Spencer will possibly enter for the St. Louis airship contest.

A CENTURY PLANT IN BLOOM.

BY ARTHUR INKERSLEY.

The "century plant" was so named because of the popular idea that it blooms only once in a hundred years. It need hardly be said that this idea (like most popular ones) is erroneous. In the genial climate of California the plant blooms in from fifteen to twenty years, but in colder climates from forty to fifty years may be necessary to bring it to maturity. The botanical name of the plant is *Agave Americana variegata*, and was given to it because of its splendid appearance. The agave is a native of Northern Mexico, where it is named the maguey, and furnishes pulque, the national drink of Mexico. In Golden Gate Park, San Francisco, the sandy soil is specially favorable to the agave, of which there are about twenty species in various stages of existence. When the plant begins to bloom, it throws up a single stalk, from which the tassel-like flowers sprout forth on either side. The great flower-stalk draws all the sap and vigor from the broad leaves of the plant, which, after it has reached its perfection, droops and dies. But at the base of the fleshy, glossy, dark-green leaves are found little suckers, each with a root, which, when planted, at once begins to grow. Though a century plant in flower is not a very uncommon sight in California, it is sufficiently so to attract considerable attention; while to most Europeans it is a very rare and wonderful occurrence. The accompanying photograph was taken by Charles Weidner, of San Francisco, and was sent by Mr. Arthur Inkersley, of the same city.



A FLOWERING CENTURY PLANT.

The Current Supplement.

In the current SUPPLEMENT, No. 1424, will be found the usual number of articles on widely different scientific and industrial topics. The London correspondent of the SCIENTIFIC AMERICAN concludes his instructive account of the use of motors in agriculture. The description of the Jaquet-Droz automatons, to be found in this issue, is supplemented by a sketch of the two Jaquet-Droz and an account of the wonderful performance of their androids. A method of refining gold by electrolysis and the use of the accumulators of electric vehicles for lighting houses, are electrical subjects that should prove of interest. Mr. Cyril Davenport dwells on the history of finger rings. Mr. Carl Hering discusses the "Latest and Best Value of the Mechanical Equivalent of Heat." The "Evolution of the Pianoforte," is traced by Mr. Randolph I. Geare in an article, very elaborately illustrated by photographs of old instruments. Alfred Russel Wallace's striking theory of man's place in the universe is criticised by E. Walter Maunder. The results of a naval inquiry as to which is the most powerful armorclad afloat are given in an analytical article.

Another competitor for the $100,000 prize offered in the aerial tournament at the World's Fair, St. Louis, has been announced. Bradford McGregor, of Covington, Ky., a designer and mechanical expert, has built a model of an airship which he says will be a success. He claims he will travel through the air from Covington to St. Louis to show that his plan of aerial navigation is correct.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

ELECTRIC DISPLAY-SIGN.—F. M. SHERIDAN and E. BEHRENDT, New York, N. Y. The inventors have provided in this invention a sign, arranged to display, by the use of electric incandescent lamps, any letter, word, sentence, ornament, or other matter appearing either stationary or movable and to allow the changing of the display in a very simple manner and without disarranging the lamps.

Engineering Improvements.

AIR COMPRESSOR.—B. GASTAL, Pelotas, Brazil. The compressor comprises two cylinders so arranged that the fall and rise of water which occurs alternately in each serves to admit air into the cylinders and then to expel the charge into a pressure tank. The flow of water into and out of the cylinders is effected by float valves.

MOTOR.—C. B. COX, New York, N. Y. The invention relates to a motor adapted to be actuated by vapor produced from a highly volatile liquid such as ether. The generation of the vapor is assisted by hot water surrounding the chamber in which the ether is contained and by hot water pipes passing therethrough.

Mechanical Devices.

CHURN.—F. SWALLOW, Miami, Indian Ter. The mechanism invented by Mr. Swallow relates to an improvement in churns, and its object is to provide one which is dasherless and performs the churning process by imparting a wave-like motion to the cream, whereby this material is rapidly churned and converted into butter with a small expenditure of power.

PUNCHING MACHINE.—W. H. PARKER, Longbranch, N. J. The idea in this invention is to provide a coin-operated machine for testing physical strength, and the result is a new and improved device arranged to correctly show, by means of an indicator, the force of the blow delivered by the operator on the apparatus.

MACHINE FOR FLANGING CAN-BODIES.—H. L. GUENTHER, Chinook, Wash. The improvement provided by this invention relates to can-making machines, and more particularly to a type of special machines employed for forming flanges on the end of cylindrical bodies of cans used for packing foods. Mr. Guenther has succeeded in providing a mechanism reliable and effective in operation and arranged to successively flange the top and bottom ends of cylindrical, oval, square, or other shaped bodies and to automatically remove the completely-flanged can-bodies from the machine.

CLUTCH-MECHANISM.—G. A. ENSIGN, Defiance, Ohio. Mr. Ensign has provided by this invention a clutch mechanism of improved design which is adapted to be readily thrown in gear by the operator whenever desired, and arranged to be automatically thrown out of gear after one revolution is made by the main or driving shaft.

COLOR-PRINTING MACHINE.—G. SCHNEIDER, Berlin, Germany. In perfecting this mechanism the designer provides a machine for printing oil-cloth, wall paper, and like fabrics, arranged to permit convenient and quick insertion or removal of the printing or pattern rollers, minute adjustment of the rollers and the color-supplies, and to give access to the supplies for cleaning, repairing, etc., thus facilitating all work before, during, and after the printing operation.

DERRICK.—C. J. REISE, Mineral, Ill. One object of the present invention is to furnish means to impart traveling motion to the platform in a manner to make it turn a complete revolution in one direction or the other. Another is to simplify the platform-operating mechanism and increase its durability by reducing the number of guide-sheaves and substituting a driving-chain for the cable, the reduced number of sheaves being arranged to utilize the service of the chain.

DRAWING-FRAME.—L. J. WRIGLEY, Lawrence, Mass. Simple means are provided here in lieu of the usual weights, springs, or levers for holding down the rolls in machines for drawing fiber, and there is provision for automatically releasing the pressure should sliver lap around drawing-rolls or other obstructions occur in the fiber. The frame may also be used in connection with railway-heads, slubbers, speeders, spinning-frames, and all machines for drawing textile slivers by means of rolls, providing for the maximum pressure to be exerted by roll pressure from below upward against bearing blocks.

PACKING DEVICE FOR DRILL-RODS OR THE LIKE.—B. SELFRIDGE, Butte, Mont. In obtaining this improvement the piston-rods of rock-drills are provided with more efficient guide and packing devices. The invention is specially applicable to rock-drillers such as the Rand or the Ingersoll-Sargeant machines, in which the pistons, the piston-rod, and the drill-chuck are integral.

BACK-SEAM TRIMMER, C. B. CORWIN, Jefferson City, Mo. The invention provides improvements in a machine which relates more particularly to a trimmer for severing the seam of a backstay. The invention may be used in connection with the shoe-lining trimmer covered by a former patent of Mr. Corwin, and when so used the same framework, gearing and knife may be employed.

Technological Improvements.

PROCESS OF PRODUCING STEEL.—P. EYERMANN, Benrath, near Dusseldorf, Germany. The process for the production of steel consists in heating the liquid pig-iron in a hearth-furnace by the combustion of poor blast-furnace gas, directing an air-blast upon the metal for effecting a preliminary refining, and finally passing blast-furnace gas through the material and burning the same in the furnace.

Miscellaneous.

LACE AND CORD FASTENER.—A. H. SMITH, Tremont, La. The device may be easily and securely attached to a shoe, glove, or other article, and it holds the lace or cord by frictional engagement therewith, and obviates tying or knotting of the lace and allows the easy manipulation thereof in unfastening it. The advantages of this device are many, as it will enable people to make the fastening of the lace more easily, quickly, and securely than any knot, and will exclude all accidental untying or hard knotting.

PHOTOGRAPHIC FILM.—W. H. SMALLEY, No. 213 Selhurst Road, London, England. In making continuous films, the object is to avoid the deterioration of sensitized film by reaction set up between salts contained in the film and the materials with which the film may be in contact. The design in this case is to prevent such chemical action between the film and the protective strip of opaque paper or light-arresting substance with which the sensitized film usually remains in long contact when stored upon the roll-holder.

SAFE.—W. P. MCKENNA, New York. The most distinguishing feature of this invention is the arrangement of the doors, which are mounted on balanced bearings and swing in the arc of a circle to cover or uncover the openings in the exterior wall of the safe. Inside is arranged a drum which is adapted to contain the valuables and which is mounted to rotate around an axis coincident with that of the movement of the safe doors.

SHINGLE-CARRIER.—A. O. BARTLETT, Paullina, Iowa. The object in this case is to provide a device for holding and carrying shingles for the use of carpenters when shingling, so as to hold a bundle in position to be taken one by one by the workman when nailing them on and to hold them in such a way that they cannot be blown off by the wind. Means are provided for raising and lowering the carrier along the roof as the work progresses.

INSECT-EXTERMINATOR.—H. H. BORING, Floral, Ark. To overcome many objections in apparatus employing steam as the destroying agent, Mr. Boring has devised and constructed an insect exterminator, using a water-tank of novel form, having within it a chimney designed to check and to a degree to hold back the products of combustion in its passage up through the tank, and thereby quickly heat and convert the water into steam.

SCHOOL-DESK.—R. G. LITSEY, Haskell, Texas. This invention is an improvement in school-desks, and is in the nature of an appliance by which they may be conveniently removed whenever desired, as when it is needed to clean the room. The cleaning of the room is not only facilitated, but can also be done much more effectively than when the desks are fixed, thus reducing the cost of sweeping and securing better results. Through certain means the device may be adapted to any number of desks in a row.

SHAVING BRUSH AND SOAP HOLDER.—A. Q. WALSH, New York, N. Y. Comprised in this invention is a handle having at one end certain peculiar means for carrying a stick of shaving-soap and a shaving brush. Preferably these means are such as will permit the removal of the brush and soap, and the handle is hollow, so that the brush and soap may be stored therein, thus making the device convenient for travelers.

DESIGN FOR A GAME-CHIP.—S. A. COHEN, New York, N. Y. This ornamental design relates to chips used in games of cards and the like; and it embodies the representation of the profile of a human head, an urn, and scrolls, inclosed in a circular border.

CRYPTOGRAPH.—L. H. WESTON, Holbrook, Ore. In this machine messages or the like may be prepared in cipher for sending, or matter received in cipher may be translated into intelligent language. It provides means by which one or more impressions prepared for transmission or circulation may be taken or secured from the apparatus. Means are provided to prevent unauthorized persons obtaining through the process of frequency or otherwise a knowledge of the key or the matter by mathematical calculations.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 4039.—For dealers in small furnishings or model parts, cams, small springs, gearing, etc.

DRAFTSMAN WANTED.—Excellent opening. Engineering Agency, Chicago.

Inquiry No. 4040.—For parties engaged in making steel stirrups of original design.

AUTOS.—Duryea Power Co., Reading, Pa.

Inquiry No. 4041.—For makers of oil pumps for gasoline motors.

For hoisting engines. J. S. Mundy, Newark, N. J.

Inquiry No. 4042.—For makers of wood-distilling apparatus.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 4043.—For manufacturers of furnaces.

Coin-operated machines. Willard, 284 Clarkson St., Brooklyn.

Inquiry No. 4044.—For a 5 h. p. water turbine and dynamos for same.

Blowers and exhausters. Exeter Machine Works, Exeter, N. H.

Inquiry No. 4045.—For makers of acetylene gas generators.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 4046.—For makers of egg cases, fillers and testers.

Mechanics' Tools and materials. Net price catalogue. Geo. S. Comstock, Mechanicsburg, Pa.

Inquiry No. 4047.—For a cheap split basket with stiff handles.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 4048.—For manufacturers of hard fiber, also for makers of automatic or lever chucks for use on turret lathes.

PATENT FOR SALE.—A. L. & O. Sovelius' Twine Holder. Price, $6,000. Hancock, Mich.

Inquiry No. 4049.—For a machine for pasting and rolling together pulp board.

WANTED.—Machinists for light work. Steady employment. W. W. Oliver Mfg. Co., Buffalo, N. Y.

Inquiry No. 4050.—For makers of ornamental iron fence for lawns and cemeteries.

Let me sell your patent. I have buyers waiting. Charles A. Scott, Granite Building, Rochester, N. Y.

Inquiry No. 4051.—For wholesale dealers in hardware, farm implements, machinery and mechanical tools of every description.

Inventions developed and perfected. Designing and machine work. Garvin Machine Co., 149 Varick, cor. Spring Sts., N. Y.

Inquiry No. 4052.—For makers of boiler furnace blowers for steam boilers.

American Institute of Inventors Co., Inc'd., Buffalo, N. Y., U. S. A. Patents sold, placed on royalty and companies formed.

Inquiry No. 4053.—For makers of knitting machines.

Manufacturers of patent articles, dies, stamping tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 4054.—For manufacturers of rubber horse shoes.

Crude oil burners for heating and cooking. Simple, efficient and cheap. Fully guaranteed. C. F. Jenkins Co., 1103 Harvard Street, Washington, D. C.

Inquiry No. 4055.—For makers of folding doors for p...ors, etc., where sliding doors cannot be used.

The largest manufacturer in the world of merry-go-rounds, shooting galleries and hand organs. For prices and terms write to C. W. Parker, Abilene, Kan.

Inquiry No. 4056.—For makers of hand and power-weaving fence machines for making woven wire fence.

MONEY-MAKING PATENT.—I will sell my patent on hat fastener, which will sell rapidly when introduced. Geo. Schmitt, Monongahela Club, Pittsburg, Pa,

Inquiry No. 4057.—For catalogues of agricultural implements, novelties, special tools, etc., for export trade.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 4058.—For a printing machine for use in printing dies in caps, etc.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $5. Munn & Co., publishers, 361 Broadway, N. Y.

Inquiry No. 4059.—For makers of white cork paint for iron castings, and information as to how to apply same.

FOR SALE.—3 h. p. marine gasoline engine. Patterns for 3 h. p. and 6 h. p. and reversing propeller. Drawings for reversing propeller. Drawings for 3 h. p. and 6 h. p. and drawings for 5 h. p. and 10 h. p.

Mr. John La Force,
3 Ketchum St., Rochester, N. Y.

Inquiry No. 4060.—For a steel hull 30 feet long, flat bottom, to draw not over ten inches loaded, propelled by stern wheel driven by gasoline engines.

Wanted—Revolutionary Documents, Autograph Letters, Journals, Prints, Washington Portraits, Early American Illustrated Magazines, Early Patents signed by Presidents of the United States. Valentine's Manuals of the early 40's. Correspondence solicited. Address C. A. M., Box 775, New York.

NOTICE TO TUNNEL CONTRACTORS.

Sealed proposals marked "Bid for Tail Race Tunnel" will be received by the undersigned until noon, May 11, 1903, for the construction of a tail race tunnel for the Toronto and Niagara Power Co., of Toronto, Ontario. Plans and specifications for this work are on file, and can be seen after March 30, 1903, at the company's offices at Home Life Building, Toronto, Ontario, and Niagara Falls, Ontario, or office of F. S. Pearson, No. 29 Broadway, New York, Room 220. The right is reserved to reject any or all proposals. Frederic Nicholls, Vice-President and General Manager, Home Life Building, Toronto, Ontario.

WANTED.—A six or eight block iron frame draw bench for drawing wire from No. 7 to No. 12; give full description. Address C. B., Box 773, New York.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(8935) T. S. asks: In a dispute I contend that substances such as iron, the heavier woods, i. e., those that have a specific gravity decidedly greater than water, will sink to the bottom of the ocean, even to its greatest sounded depths. I contend that this would be the case with iron were that depth 20 miles. I take my stand on the very slight compressibility of water. A. Water is compressible to only one twenty-thousandth part for one atmosphere, or 15 pounds per square inch. Sea water is still less compressible, its coefficient being 44 millionths for one atmosphere. At the depth of one mile it will be but a one-hundredth part greater. Water does not increase much in density from the surface to the bottom of the ocean, even at its greatest depths. Any article which will sink at the surface of the ocean will continue to sink till it rests upon the bottom. There is no level at which sunken ships and men float and cease to sink.

(8936) A. H. P. asks: The lower half of the wires in an upright piano have rusted, so that one wire broke. What treatment can be given the wires to remove the rust and prevent further damage? Would a box of charcoal or lime set inside be of any service? A. Kerosene oil is one of the best articles to remove rust from iron or steel. If the wires of your piano are wiped over occasionally with it, they will not rust. Charcoal would not be of any service to prevent rust, and lime would be of little service.

(8937) O. D. asks: What composition is used to make the Welsbach gaslight mantles? A. A fabric of cotton is woven of the desired form, and this is impregnated by repeated dipping in a solution of thorium and cerium nitrates. On ignition, the cotton burns away and the nitrates are converted into oxides, which give the intense luminosity. Other nitrates of the rare earths, as also of zirconium and magnesium, have been used; but the thorium-cerium mixture gives the best results. A ratio of 99 per cent thoria and 1 per cent ceria has been found to give the maximum luminosity

(8938) F. P. C. says: Please advise me which side of a 500-volt railway generator is connected to the rails. A. The negative side of a street railway generator is connected to the rails, and the positive side to the trolley wire. See Tooter's "Electrical Engineer's Pocket Book," page 508, etc.

(8939) H. P. W. asks: If I run the exhaust pipe of a gasoline engine into a well lined with brick, and run a pipe from top of well into open air, what would be the exhaust pressure at top of pipe out of well? Well 4 feet in diameter, 8 feet deep; engine cylinder 11x18 inches; revolutions 200 per minute; engine has 65 pounds compression. Or, if we assume that the exhaust is relieved at 50 pounds pressure at exhaust port, what would be the actual and theoretical pressure at end of pipe leading out of well? A. The back pressure of your exhaust pipe at its end, as you describe, will depend on the size of the pipe. It should be no more than three pounds per square inch if the pipe from the well is one size larger than the engine exhaust pipe.

(8940) I. L. G. asks: Is there any kind of a composition or solder to solder copper and cast iron together, or is there any way to prepare cast iron so that it can be united with copper? A. Cast iron and other metals may be soldered together by first tinning the cast iron surface. This may be done on small work by a tinsmith's copper and pure tin. The cast-iron surface must be scraped with a file and rubbed with sal-ammoniac, when the tin may be rubbed on the surface with the hot copper.

(8941) C. P. L. asks for some formula for a fireproof cement suitable for setting earthenware tiles around a fireplace. Portland cement, and cement and mortar, will not stand the action of the fire. A. Fire clay mixed with silicate of soda solution has given good satisfaction; only as much should be made up at a time as can be used immediately, as it has a strong tendency to harden. A mixture of equal parts of powdered peroxide of manganese and zinc white, mixed with silicate of soda solution, is also very good. Use immediately.

(8942) B. H. G. asks: How much power will it require to run a 1 horse power electric generator? And if a generator can be run by a water motor? The address of a house that handles generators? A. One and a quarter actual horse power will run a one horse power generator. Water power is proper, and the most economical wherever available.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending

April 7, 1903,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Agricultural purposes, motor tractor for, D. Albone 724,531
Air and gas engine, J. B. O'Donnell 724,606
Albuminate and albuminate containing material, durable elastic, A. V. H. F. C. Clauson-Kaas 724,810
Alloys, producing, W. C. Tilden 724,524
Amusement apparatus, C. R. Culver 724,672
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Bearing, ball, E. J. Farr 724,834
Bearing, shaft, W. L. Webster 724,976
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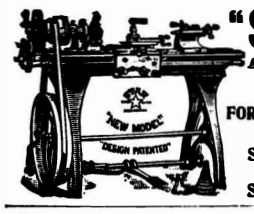

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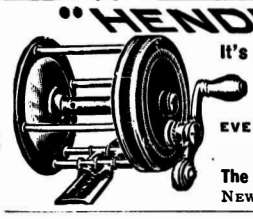

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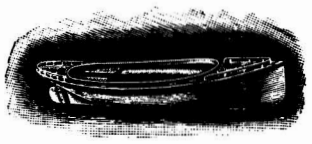

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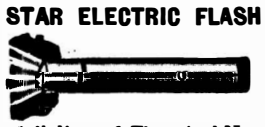

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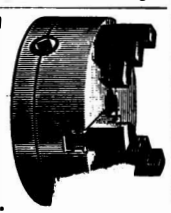

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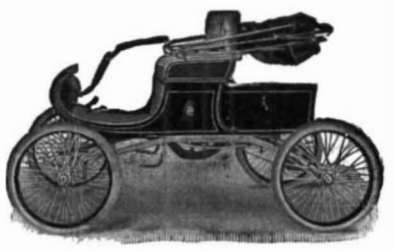

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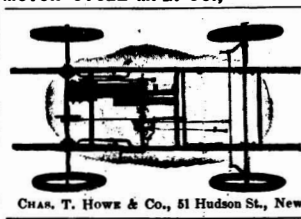

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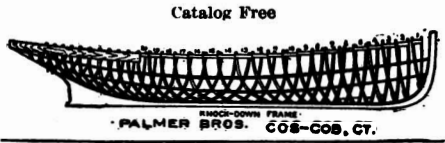

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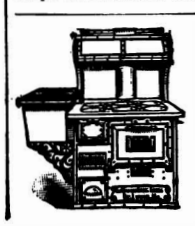

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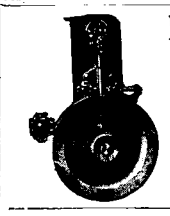

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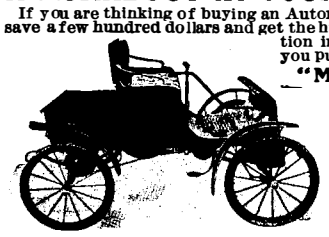

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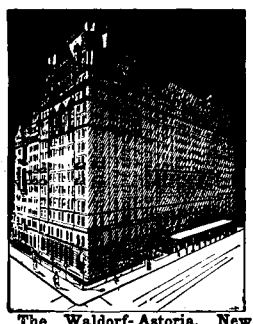

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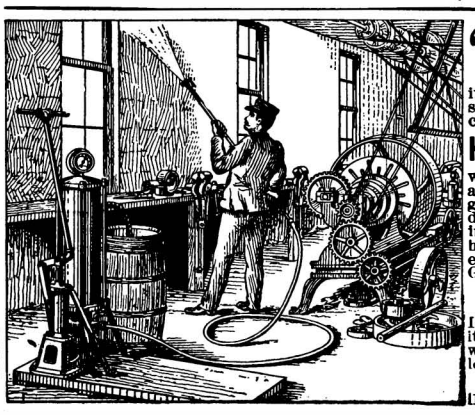

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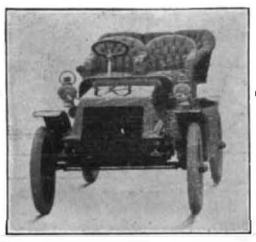

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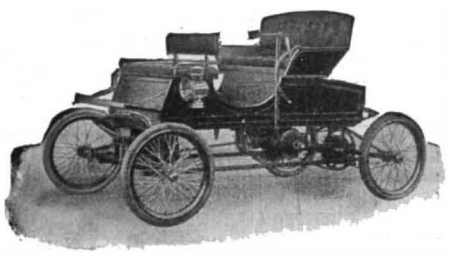

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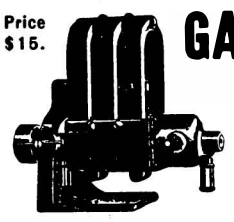

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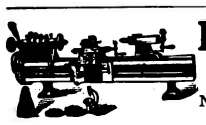

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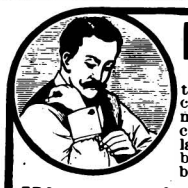

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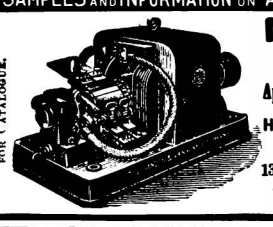

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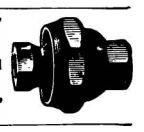

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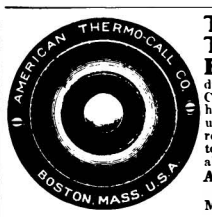

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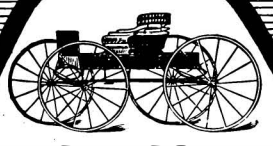

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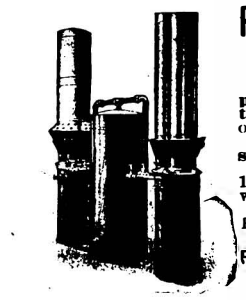

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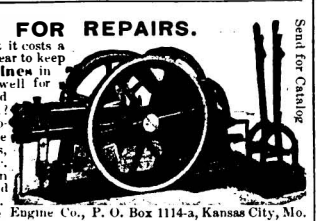

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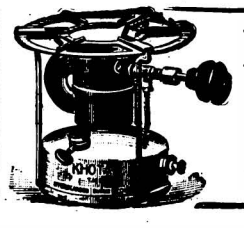

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